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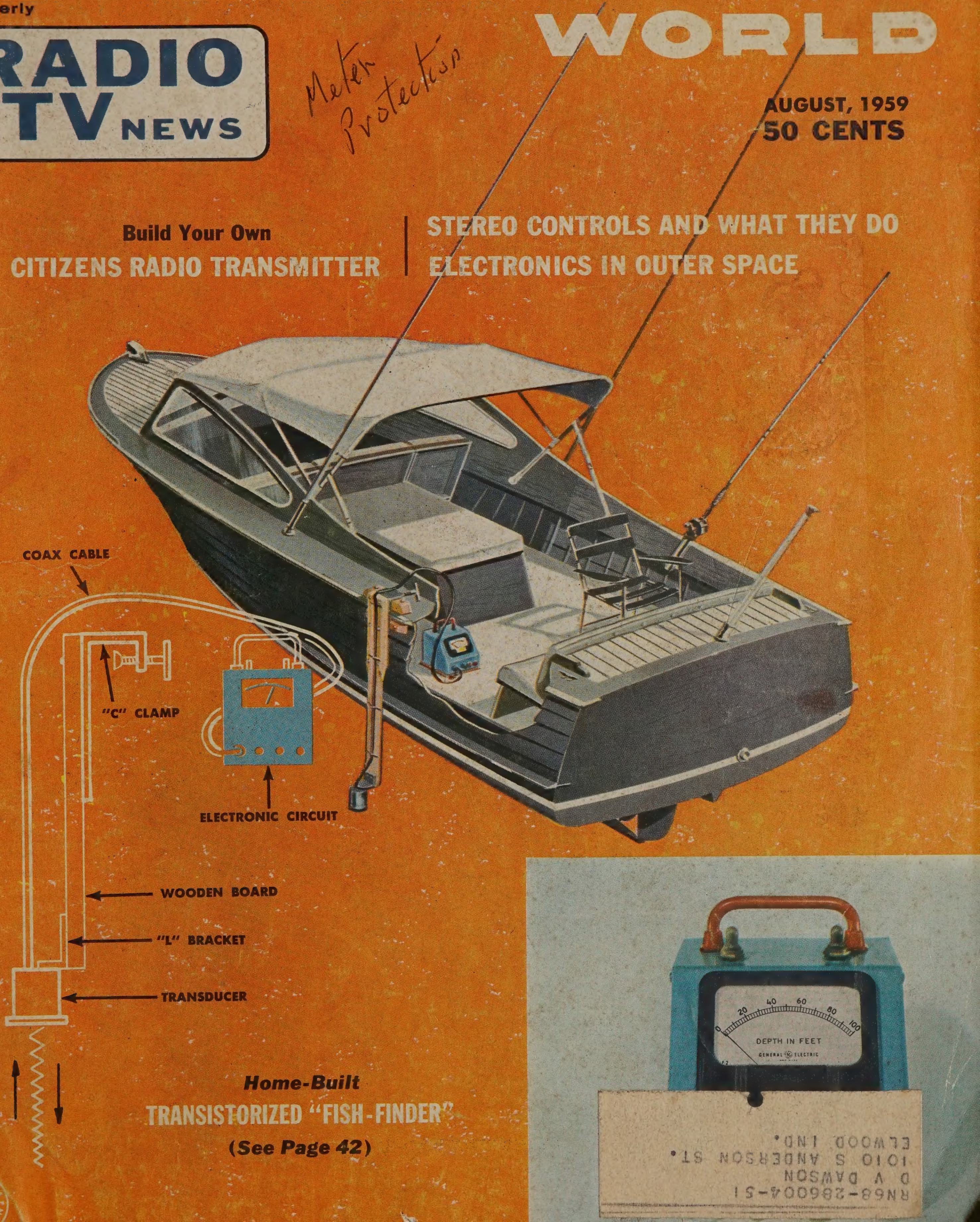
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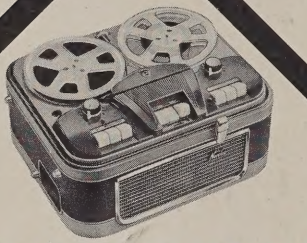

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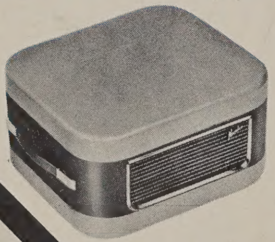

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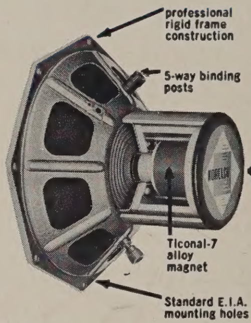
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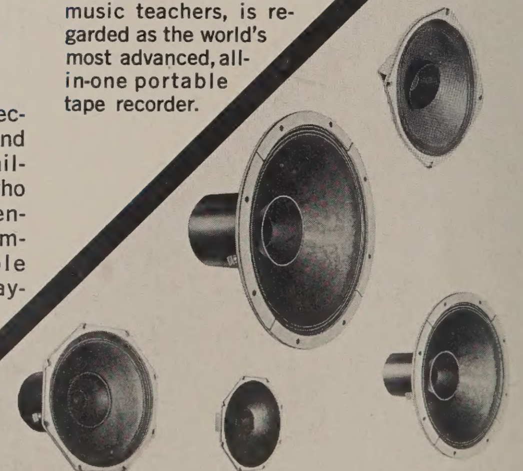

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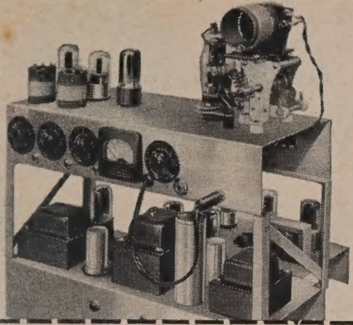

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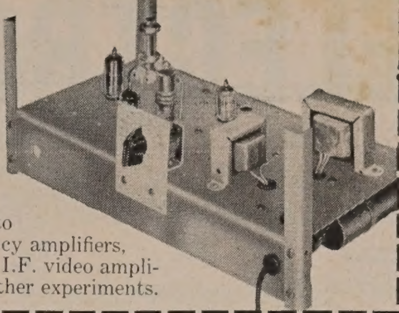

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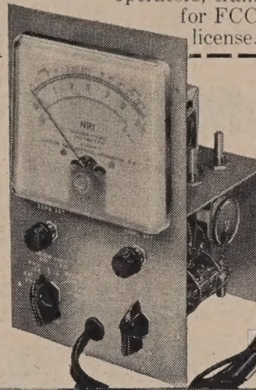

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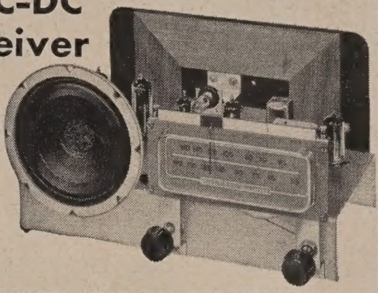

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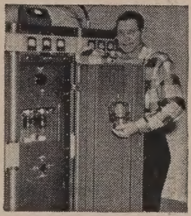

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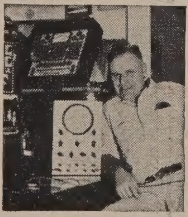

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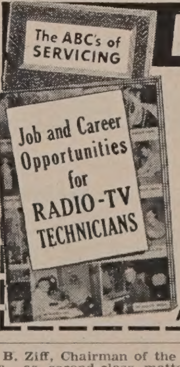

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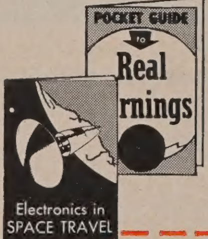
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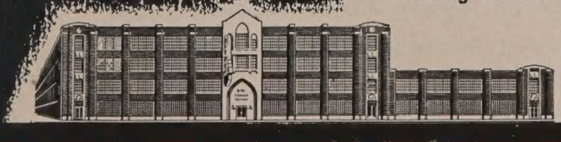

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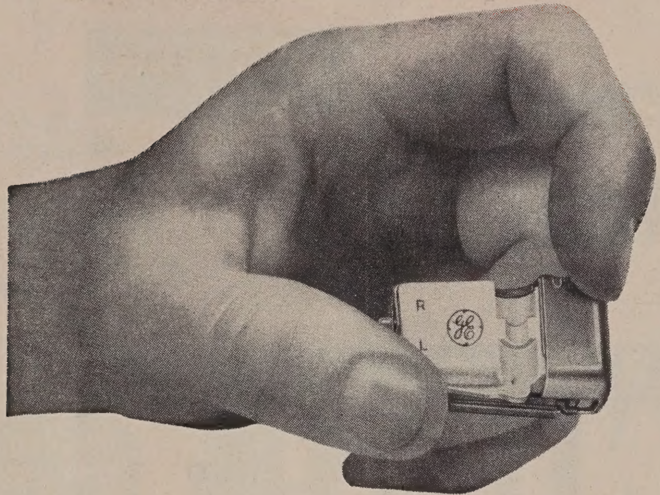

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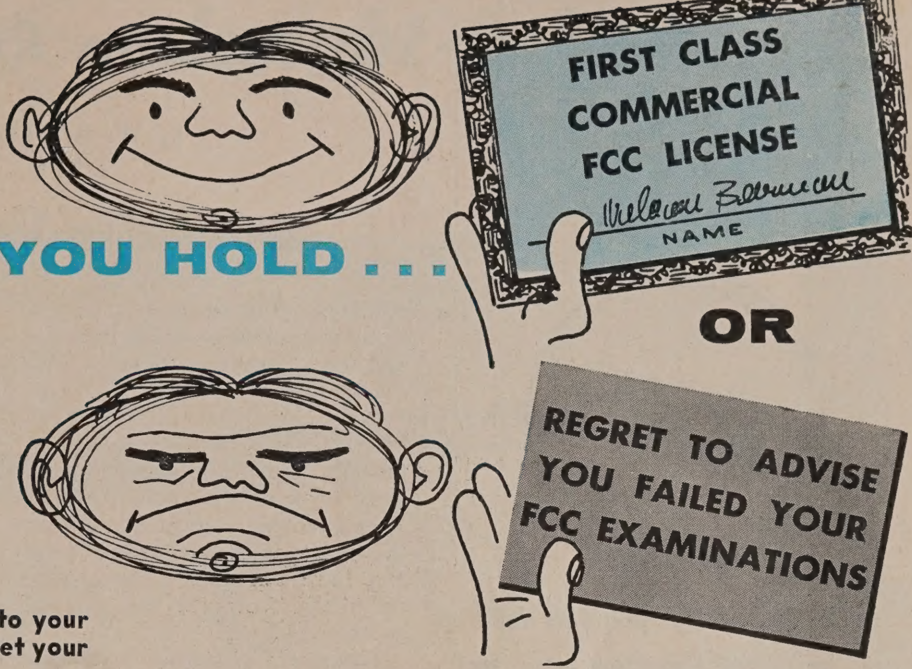
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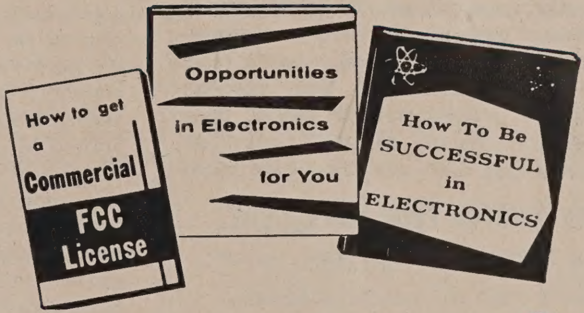
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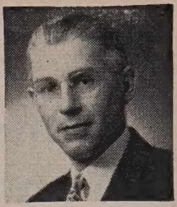

By **W. A. STOCKLIN**
Editor

Stiff Competition Ahead For Parts Industry

COMPONENT manufacturers, those companies which produce resistors, capacitors, tubes, speakers, transistors, etc. are the backbone of the entire electronics industry. Most of them are "old-timers"—those who started in the early days of the radio receiver. They have met competition during the years as it confronted them and have remained a financially stabilizing factor in the over-all industry.

Times are changing and component manufacturers will shortly be faced with the stiffest competition that they have ever had—competition from foreign manufacturers merchandising their products in this country.

This is not an entirely new manifestation but it hasn't posed a serious threat to date. We are all aware of the many high-fidelity products from Europe that are appearing on the American market. We also know that various components, particularly capacitors and resistors, are being purchased abroad by American set manufacturers and we are aware that a few tube manufacturers are importing tubes from Europe. However, all this activity thus far has not added up to really serious competition. But, conditions are changing. Starting this Fall, Japanese manufacturers will export components such as resistors, capacitors, and vacuum tubes in large volume.

Let's not sit back and cry out that it is unfair competition. Actually, it is not. Japan has come a long way from the early years after the war when they were severely criticized for simply copying American designs. Today they are a nation with engineering and scientific ability not too far removed from that encountered in the United States. They do lack automation facilities but in lieu of this they have a vast pool of manpower which is available at a much lower wage scale than ours. They can produce, in large quantities, products equal in performance to their American counterparts and, in many cases, the Japanese maker will be able to market these items at a lower price than comparable products manufactured in the United States.

The tide is changing and every component manufacturer should be alert to what will be confronting him. The answer, although simple to put in words, will be difficult to implement. Every U. S. manufacturer should resolve to produce the best quality products and reduce costs by further automation. In many cases the basic design of a component will have to be changed to meet this objective. For example, *RCA*'s new "Nuvistor" (described in our May issue) involves the first major change in tube design in many years. It is a metal tube and because all glass and mica have been eliminated in its construction the company should be able to produce vacuum tubes in the near future that will be far superior to any of the present glass versions. This is a major break-through which may act as a deterrent to increased importation of foreign tubes. Manufacturers of other components should view this achievement as an example of the type of drastic changes that may be necessary to hold their markets in their particular fields.

Diversification to less competitive items will be the answer for many manufacturers.

Another trend in sight is that some manufacturers will be forced to drop production in this country and license foreign manufacturers to fabricate products for them. These would be marketed through their own distributing channels or used directly in their own end products.

These are just some of the facts. There are many other portents and those who are alert to the problem and are making plans for the future to counteract such competition will find their paths easier. The right path, of course, is the one that will make available to the consumer better products at lower cost. It will be this "competitive advantage" that will pay off handsomely in the long run.

—30—

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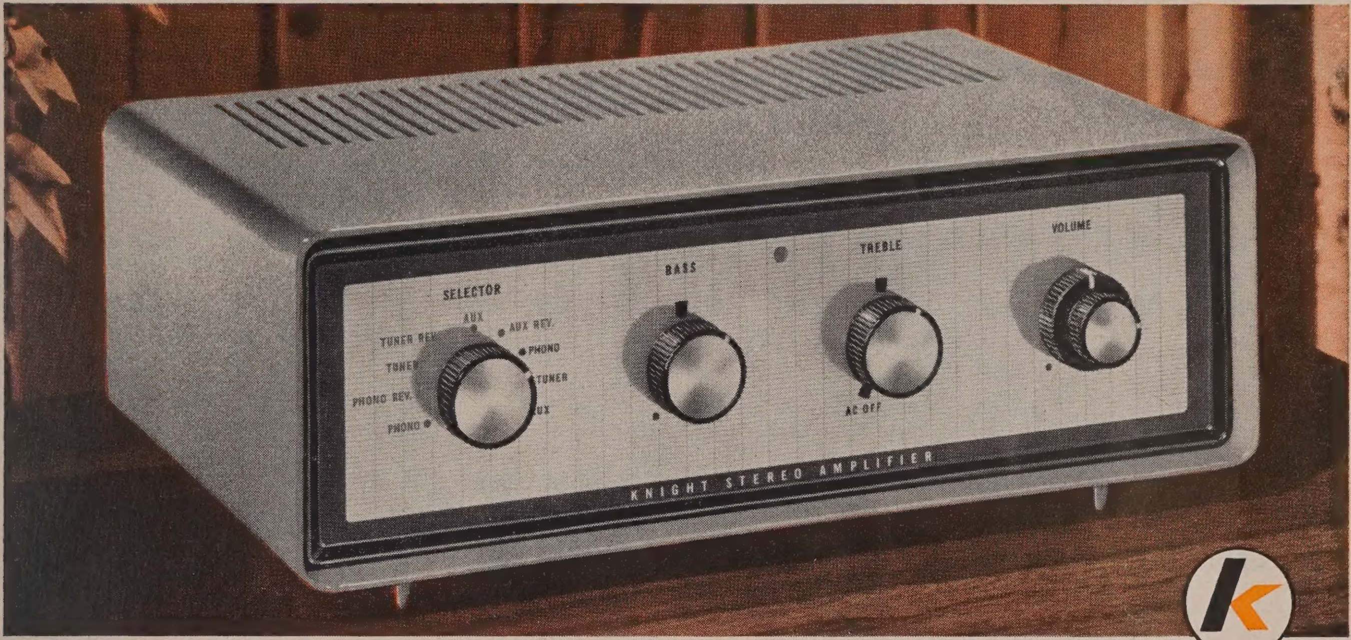

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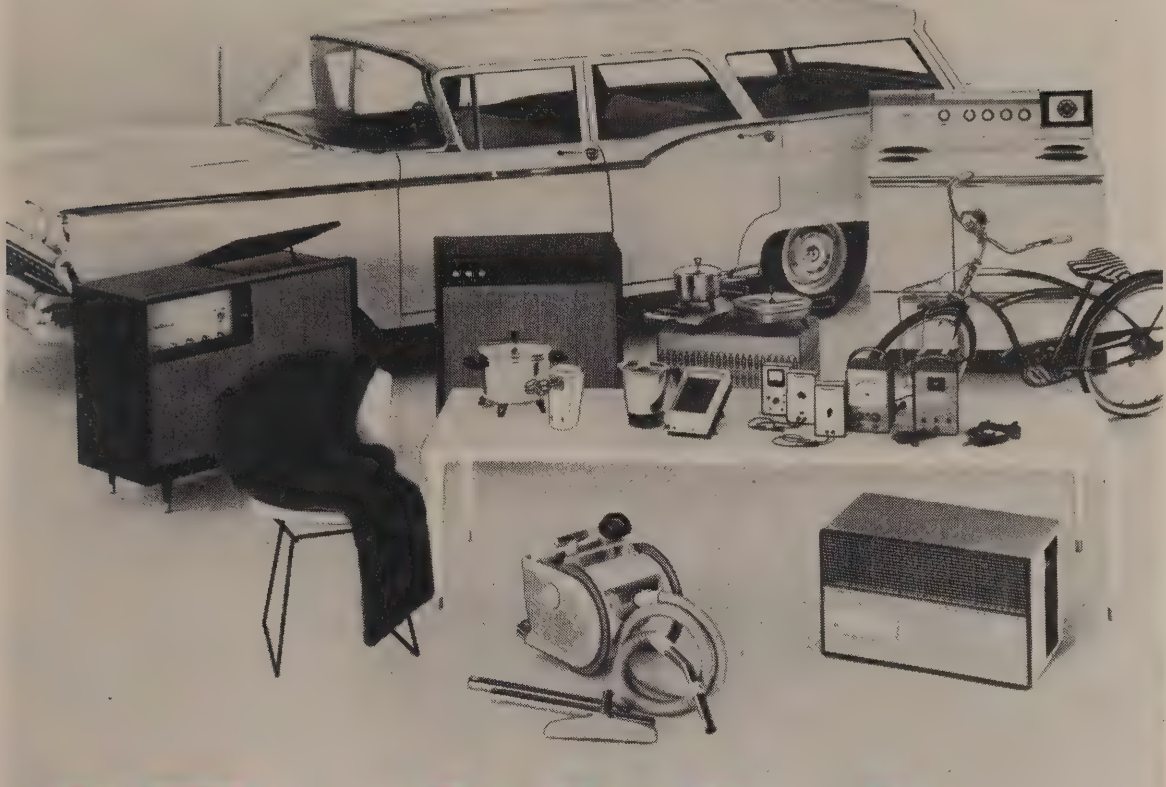

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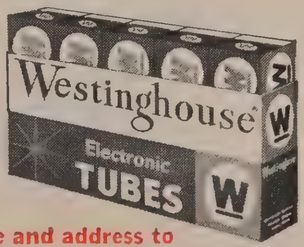

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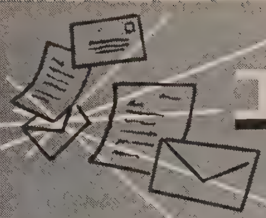

Letters from our Readers

STEREO TEST RECORD

To the Editors:

This is to let you know how pleased we are with your stereo-monophonic test record. The channel identification test and speaker phasing check worked out very well and were certainly most useful.

Also, you are to be congratulated on actually being able to record a 15-kc. signal at a usable level on a 7-inch disc.

David Andrews
New York, New York

We appreciate Reader Andrews' comments on the record. The job certainly was not easy, particularly the recording of 12 and 15 kc. on the 7-inch disc. However, we were gratified to find that the result was well worth all our efforts.—Editors.

* * *

OUR NEW NAME

To the Editors:

Having read Radio & TV News and its predecessors for some thirty years, I believe it is time that I should tell you that every issue that I have read has been enjoyed at least in part, for no human can please all other humans at all times in everything. In general, your publication has been instructive, constructive, and progressive.

I certainly wish that Electronics World will enjoy the success and acceptance in the future that its predecessors have had in the past.

Arthur C. Languirand
Newport, Rhode Island

We certainly appreciate the comments of Reader Languirand and the many others who have written in their comments and good wishes on our new name, Electronics World.*—Editors.*

* * *

DYNAMIC SIDEBAND REGULATION

To the Editors:

In your March, 1959 issue, an article entitled "Dynamic Sideband Regulation Used in New Tuner" by R. Berkovitz was published. We would like to point out that there has been considerable original work in this general area. To substantiate this, we would like to list the following articles written on the subject of feedback in FM systems.

1. Carson, J. R., "Frequency Modulation: The Theory of the Feedback Receiving Circuit," *Bell System Technical Journal,* pp. 395-403, July, 1939.
2. Chaffee, J. G., "The Application of Negative Feedback to Frequency Modulation Systems," *Bell System Technical Journal,* pp. 404-437, July, 1939.
3. Panter, P. F. and Dite, W., "Application of Negative Feedback to Frequency Modulation Systems," *Electrical Communication,* pp. 173-178, June, 1949.
4. Bell, D. A., "Reduction of Bandwidth in FM Receivers," *Wireless Engineer,* pp. 497-502, November, 1942.
5. Clavier, A. G. and Phelizon, G., "Paris-Montmorency 3000-Megacycle Frequency Modulation Radio Link." *Electrical Communication,* pp. 159-169, June, 1947.

Also, the following patents have been issued: British Patent No. 531779 and U. S. Patent No. 2075507. The article states that D.S.R. is a new FM circuit development. We felt you would want to learn of the above references.

A. J. Chimera & R. H. Haungs
Cornell Aeronautical Laboratory, Inc. of Cornell University
Buffalo, New York

Although the idea for the circuit described in the article may not be brand new, certainly its application in the field of an FM broadcast tuner is novel. As a matter of fact, the Allied *"Knight" tuner is the only commercially available FM tuner to our knowledge that incorporates such a circuit.—Editors.*

* * *

TRANSISTORIZED PHONO PREAMPS

To the Editors:

Transistors are claimed to be ideal for phono preamps because they have low impedance and they eliminate the hum problem. If this is true, can you refer me to a circuit design for a quality hi-fi unit? And on the contrary, if transistors are not suited for preamps, I would be interested in knowing why.

Robert L. Jamison
Whittier, California

Many of our readers appear to be interested in this subject. We would, therefore, refer Reader Jamison and the others who have written to the article "Transistorized Phono Preamp for Stereo" by Francis A. Gicca which is running in this issue. Our July issue contained an all-transistor stereo tape system with a well designed transistor front end for tape usage. In addition, we have several other articles on phono preamps that are scheduled for future issues.—Editors.

* * *

TV SERVICE AND THE LADIES

To the Editors:

I am sorry to go all "Susan B. Anthony" on you—but really your article "TV Service and the Ladies" in the June issue can't go unchallenged!

While our male contemporaries were overseas during World War II, who do you think was assembling and testing the electronic equipment being

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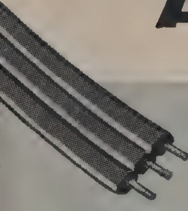

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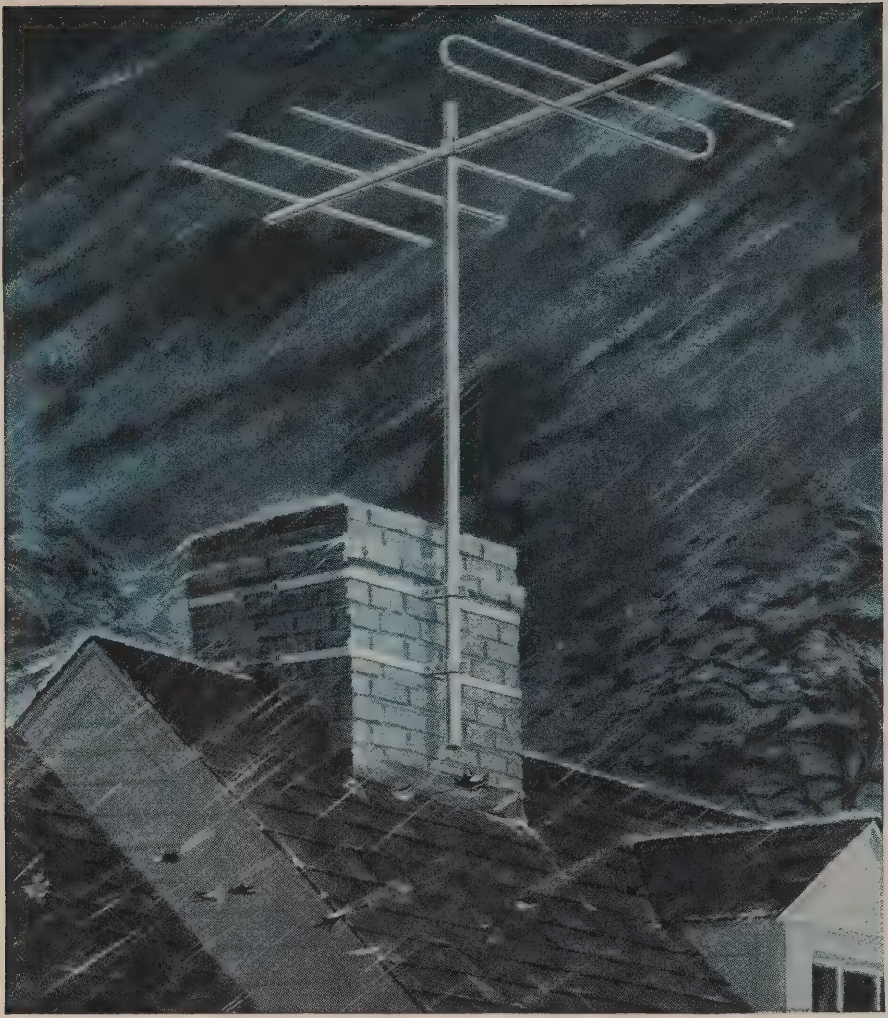

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used by the various services? Do you recall that much of the electronic gear—both civilian and military—was serviced by gals—some in uniform and some not? What about the countless YL's who hold ham tickets and give generously and selflessly of their time—so much so that in 1956 the coveted Edison Award went to Mary Burke!

How many manufacturers of electronic equipment would be forced to close down if their female personnel decided to become "American Housewives" en masse? Please fellows, Queen Victoria is long gone, and with it the uninformed and untutored spouse. If today's woman professes a total ignorance of "things technical," it is probably because she wants to make some hulking male feel mighty pleased with himself and his superior knowledge. Don't let the "Mrs. Armstrongs" fool you, boys—they might turn out to be "grandmas!"

Mrs. Archie Roth
New York City, New York

We're with you, Mrs. Roth! To judge by the article's concluding incident, in which "grandma's" familiarity with electronics stuns the technician, we suspect the author would join us in admitting that there are, on the one hand, many "Mr. Armstrongs" whose ignorance could drive any technician to distraction and, on the other hand, many females commendably knowledgeable in the field. To the latter, we doff our hats.—Editors.

* * *

KUDOS FROM ISRAEL

To the Editors:

Owing to a road accident, I am now covered with plaster, confined to my bed, and am not in a very convenient writing position. But I want to take this opportunity between changes of my cast to thank you for an excellent magazine. It represents the only link between me and the electronics world abroad. I look forward to each new issue where all the new accomplishments and new products are described.

Raanan Rubinstein
Tivon, Israel

We appreciate Reader Rubinstein's comments as well as the extensive number of suggestions made for possible future articles and wish him a speedy and complete recovery.—Editors.

* * *

BASS-REFLEX ENCLOSURES

To the Editors:

In discussing impedance as a measure of cone movement ("Reflex Enclosures—How They Work," June, 1959 issue) a comparison is made between reflex and sealed enclosures in regard to the amount of loading imposed on a loudspeaker at bass frequencies.

A reader may get the idea that a reflex enclosure loads its speaker more heavily than a sealed enclosure *of the same size.* This is obviously not true, as a glance at the impedance curves of Fig. 6 will show. Assuming both types of enclosures have the same volume,

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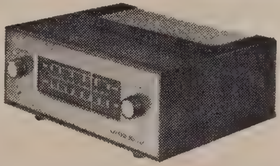

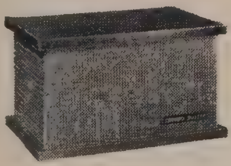

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the system resonance of the sealed enclosure is higher than that of the reflex cabinet, but below system resonance the cone is heavily loaded by the stiffness of the trapped air. Bass response is correspondingly limited.

The reflex enclosure, on the other hand, gives more uniform loading down to system resonance. And the resonant frequency is lower than that of a sealed enclosure the same size. Below system resonance, however, the reflex enclosure rapidly unloads its driver, although motional impedance never reaches as high a value as at the sealed system resonant frequency.

If a loudspeaker in a matched reflex enclosure is compared to the same speaker in a very large sealed enclosure (infinite baffle), then the statement is true that the cone moves farther and farther at progressively lower frequencies. And the frequency of *maximum* cone excursion in the infinite baffle is the same as that of *minimum* cone excursion in the matched reflex enclosure. Thus, a reasonably efficient loudspeaker having a free-air cone resonance in the 35-60 cps range will give more extended bass response in a reflex enclosure as compared to a sealed cabinet of the same size (Fig. 5). It will give more bass response *and* handle more bass power when mounted in a reflex enclosure than in an infinite baffle.

George L. Augspurger
Beverly Hills, California

* * *

CITIZENS BAND TRANSCEIVER

To the Editors:

Five associates and I built the transceiver described in your March, 1959 issue. We have all succeeded in getting the transmitter to work, but we had some problem with the receiver. After we took your advice, however, and increased the number of turns on *RFC*$_1$ from 50 to 75, every one of us was able to get the receiver to work.

In fact, I logged 45 stations between the hours of 8:00 p.m. and 10:00 p.m. that same evening including a phone-patch and conversation between a 10-meter ham in the Canal Zone and a relative in Massachusetts, more than a dozen South American, Puerto Rican, and Central American hams, and a number of others at widely separated points on the eastern seaboard. In fact, one of the pleasant things about this experience was to listen to three mobile transmitters whose owners state that they were operating on 10 watts or less! So far, none of us has logged any Citizens Band operators on the east coast, which may indicate that the interest in this band is relatively recent and that licenses have not yet been received—my own included.

William H. Cummins
Linthicum Heights, Maryland

Thanks to Reader Cummins for the above comments on the transceiver. We would also like to point out another Citizens Band transmitter in this issue.—Editors. —30—

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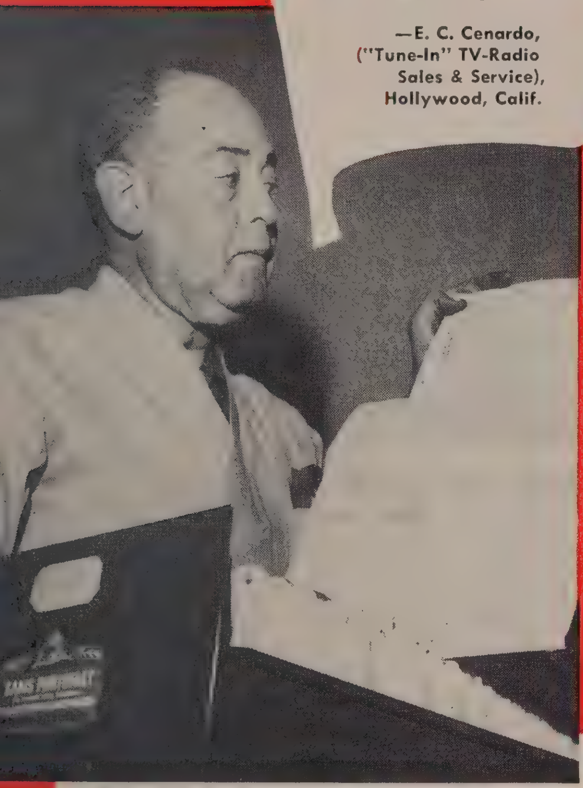

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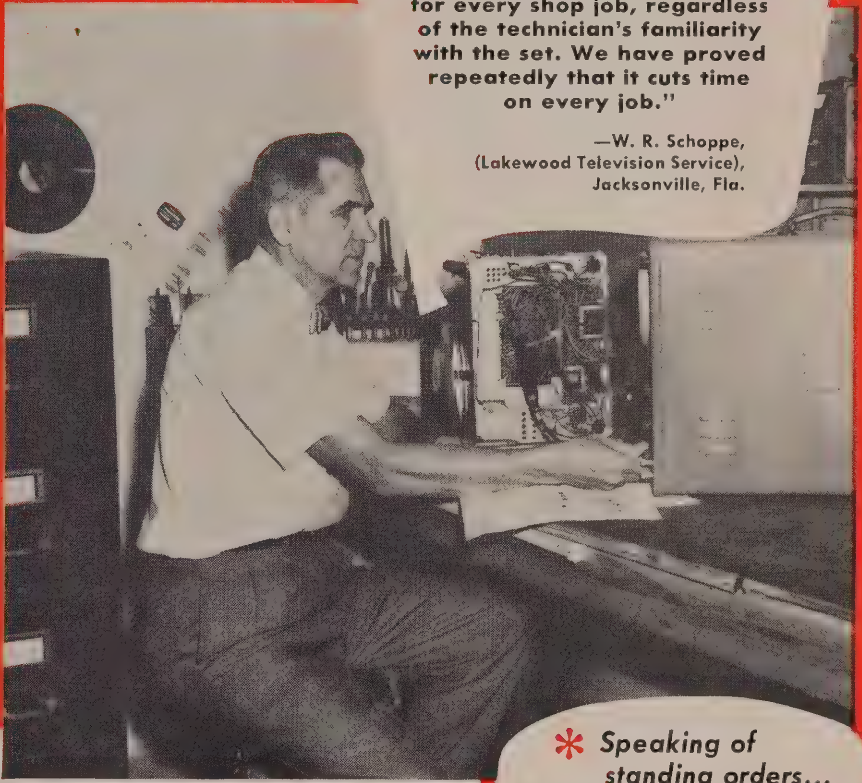
—W. R. Schoppe,
(Lakewood Television Service),
Jacksonville, Fla.



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—James G. Haynes
Leitchfield, Ky.

"The PHOTOFACTS that I have purchased on the Easy-Buy plan have been paying for themselves each month."
—Donald Johnson
Hector, Minn.

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—Frank J. Schumacher
Hillsboro, Ore.

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—Joseph S. Musil
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—Wesley F. Scott
Logansport, Ind.

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—E. R. Hayes
Clemson, S. Car.

(These are just a few of the hundreds of "Success with PHOTOFACT" letters in our files)

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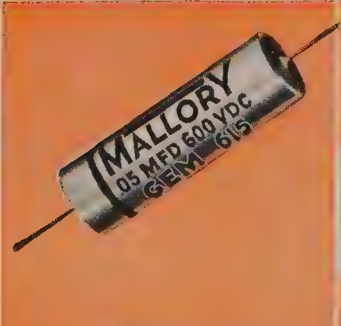

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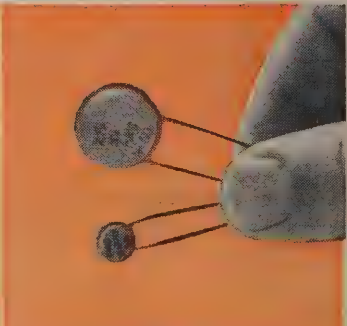

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Beri Moore, P.O. Box 169, Opp, Alabama	1st	15
Donald R. Titus, 270 Park Terrace, Hartford 6, Conn.	1st	12
Robin O. Okinishi, P.O. Box 375, Hanapepe, Kauai, Hawaii	1st	12
Billy R. Kirby, Route #3, Smithfield, N. C.	1st	9
J. H. Reeves, 10621 Ruthelen, Los Angeles 47, Calif.	1st	12
Donald H. Ford, Hyannis Rd. (Cape Cod), Barnstable, Mass.	1st	12
James D. Hough, 400 S. Church St., East Troy, Wisc.	1st	12

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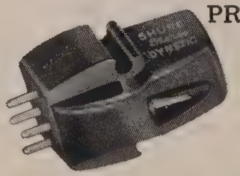

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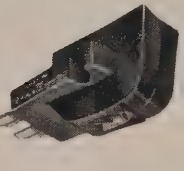

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Within the Industry

RICHARD D. SHARP has joined *Packard Bell Electronics Corporation* as director of marketing, home products division. In this newly created position Mr. Sharp will supervise the advertising and sales of television, radios, stereo hi-fi, garage door operators, and wood products. He will also direct merchandising activities of the company's Distributor Corporation.

Mr. Sharp was formerly general manager of *United Printers,* Joliet Division; vice-president in charge of sales for *Scott-Atwater Co.;* and manager of retail sales promotion for *Standard Oil Co. of Indiana.*

* * *

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS recently commemorated its founding meeting which took place 75 years ago. The organization is marking its Diamond Jubilee Year.

The AIEE, whose 1884 roster listed 71 members, among them Thomas Edison and Alexander Graham Bell, is now a world-wide organization with a membership exceeding 52,000. The original organizational meeting took place in New York City at the offices of the American Society of Civil Engineers. Norvin Green, president of the *Western Union Telegraph Co.,* was elected the first president of the association.

* * *

MAJOR GENERAL RALPH T. NELSON has been appointed the eighteenth Chief Signal Officer of the United States Army.

General Nelson's appointment climaxes a military career of more than thirty years with the United States Army. Born in Lebanon, Indiana, he attended Purdue University and was graduated from the United States Military Academy in 1928.

He is the holder of the Legion of Merit, the Bronze Star Medal, the Purple Heart, and the Korean Ulchi with Silver Star.

* * *

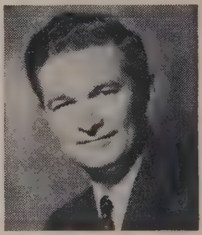
ELECTRON TUBE INFORMATION COUNCIL has been formed by eight of the nation's leading receiving tube manufacturers. The new *ad hoc* group has these objectives: "to promote the use of tubes in those electronic applications where they offer superior properties; to emphasize the engineering factors involved in the selection of alternative electron valve-type devices; and to focus attention on new trends and developments in tube technology."

Members of the Council include: G. H. Gage, *CBS Electronics,* Kenneth A. Waldron, *General Electric* receiving tube dept.; William Peltz, *Lansdale Tube Co.,* a division of *Philco Corp.;* G. J. Janoff, *RCA* electron tube division; Julius Dorfman, *Raytheon* industrial and receiving tube divisions; R. P. Clausen, *Sylvania* electronic tubes division; C. E. Coon, *Tung-Sol Electric Inc.;* and Louis Martin, *Westinghouse* electronic tube division.

The Council is open to all tube manufacturers.

* * *

FRANK RANDALL, president of *Amperex Electronic Corporation,* has been elected vice-president of *North American Philips Company, Inc.* The electron tube and semiconductor manufacturing firm is an affiliate of *N. A. Philips.*



Mr. Randall retains his position as president of *Amperex* as well as vice-president and director of *Ferroxcube Corporation of America,* also an affiliate organization.

* * *

RCA SERVICE COMPANY has broken ground for a new 35,000 square-foot addition in Riverton, N. J. . . . **SERVICE INSTRUMENTS CORP.** has added another new and large factory building to its facilities . . . **EITEL-McCULLOUGH, INC.** has dedicated its new facilities at 301 Industrial Way, San Carlos, California . . . **THE GABRIEL COMPANY** has announced plans for immediate construction of a large manufacturing plant at Mesa, Arizona . . . **OPAD ELECTRIC COMPANY** is now at 43 Walker Street, New York 13, N. Y.

* * *

DR. CHARLES E. DEAN, consulting engineer of *Hazeltine Research Corporation,* a subsidiary of *Hazeltine Corporation,* has received a national award for his outstanding service to the Institute of Radio Engineers' Professional Group on Broadcasting and Television Receivers.

The plaque was presented for Dr. Dean's efforts in the publication of the Professional Group's quarterly, "Transactions."

Dr. Dean is the historian of the IRE's Long Island Section, secretary of the EIA's Committee on Color Motion Picture Film for Color TV, vice-chairman of the American Institute of Electrical Engineers' Communications Division Committee, chairman of the Television Allocations Study Organiza-

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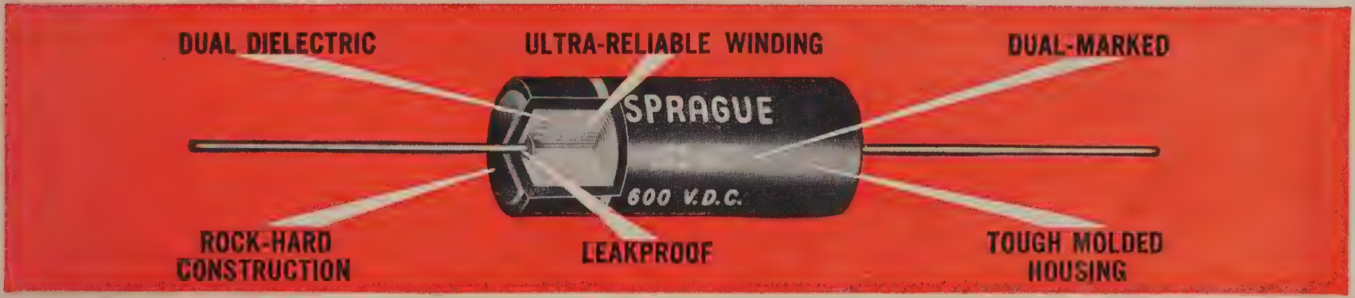

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tion's Panel 6, and a member of the Radio Receivers Committee of the IRE. In addition to holding degrees from Harvard, Columbia, and Johns Hopkins Universities, Dr. Dean has been a licensed engineer for the past 25 years. He is a Fellow of the AIEE and the Radio Club of America, Senior Member of the IRE, and a member of the SMPTE.

* * *

D. R. HULL has been re-elected president of the Electronic Industries Association for a second year. Serving with Mr. Hull will be all five of last year's vice-presidents; Leslie F. Muter, the treasurer; and James D. Secrest, executive vice-president. Six new directors, two new division chairmen, and one department head were elected. All other directors and division chairmen were re-elected.

Dr. W. R. G. Baker was elected to a new position of director emeritus of the Engineering Department. The resignation of General Counsel William L. Reynolds was accepted. He will become the general attorney for *Litton Industries, Inc.* of Beverly Hills, Calif.

* * *

BURT C. PORTER of *Burt Porter, Inc.* was re-elected president of the Electronic Representatives Association (ERA) at a recent meeting of the association's national board of governors. John O. Olsen of Cleveland was again named chairman of the board.

Named as regional vice-presidents were: Wally Shulan, Jersey City, N. J., eastern district; Charles Hoemig, Fort Wayne, Ind., central district; Allen I. Williams, Jr., Denver, Colo., western district. E. Edward Stemm and Harry Halinton, both of Chicago, were re-elected to the posts of secretary and treasurer, respectively.

* * *

HAROLD S. GENEEN has been named to succeed **EDMOND H. LEAVEY** as president and chief executive officer of *International Telephone and Telegraph Corporation.* He resigned as executive vice-president of *Raytheon* to assume the new post . . . **DR. WILLIAM M. WEBSTER** has been appointed Administrative Engineer on the staff of the vice-president of *RCA Laboratories.* He will handle special assignments relating to various aspects of the over-all *RCA* research program . . . **SIDNEY NORINSKY** is the new advertising manager of *Electronic Measurements Co., Inc.,* Eatontown, N. J. electronic equipment manufacturer . . . **F. R. MACKLIN** is the new sales and advertising manager of *Communications Company* of Coral Gables, Fla. He has been with the firm since 1951 . . . **SAMUEL W. STEWART** has assumed the post of director of engineering for the *Gabriel Electronics Division.* He was formerly associated with *Sperry Gyroscope Co.* . . . **LOUIS R. WANNER** has been named to the newly created post of chief engineer of the parts division of *Sylvania Electric Products Inc.* He will make his headquarters at the firm's plant in Warren, Pa.

* * *

UNIVERSITY LOUDSPEAKERS, INC. of White Plains, N. Y. has been purchased by **LING ELECTRONICS, INC.** of Los Angeles. The speaker firm will become a wholly owned subsidiary of the L. A. company. No changes in operation or personnel are contemplated . . . The assets and business of **SORENSEN AND CO., INC.** have been purchased by **RAYTHEON COMPANY** . . . **POTTER & BRUMFIELD, INC.,** a subsidiary of **AMERICAN MACHINE & FOUNDRY COMPANY,** has become a division of **AMF.** The new division, which has plants in three cities, is one of the country's largest suppliers of electromagnetic relays . . . **P. R. MALLORY & CO., INC.** and **ARBAME S. A.** of Brazil have agreed to set up a new capacitor manufacturing firm in Sao Paulo. The new company will be known as **ARBAME-MALLORY S. A.** . . . **GENERAL INSTRUMENT CORPORATION** has acquired **HARRIS TRANSDUCER CORPORATION** of Woodbury, Conn. The Connecticut firm will operate as a subsidiary under its present management.

* * *

RAYTHEON COMPANY'S Distributor Products Division has begun construction on a new headquarters building in Westwood, Mass. The modern brick structure will cover 60,000 square feet on a five-acre site in the Westwood Industrial Park, 10 miles south of downtown Boston . . . **HAZELTINE CORPORATION** of Little Neck, New York has announced the establishment of a new 50,000 square-foot engineering lab-

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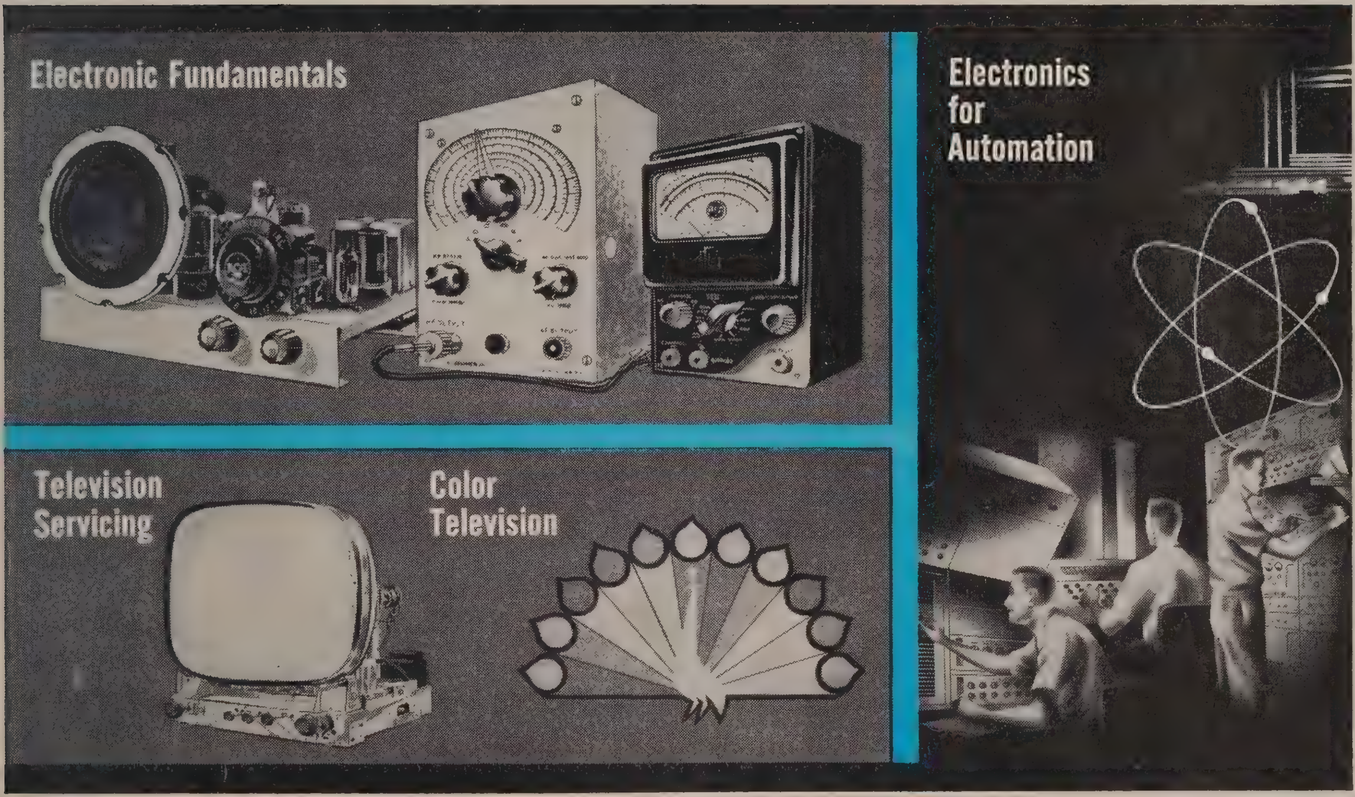
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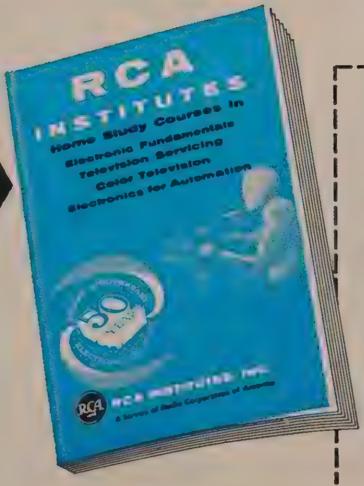
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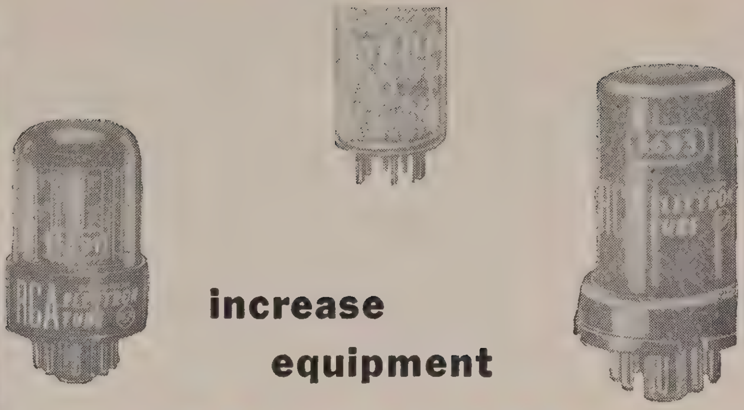

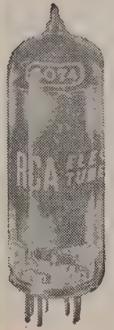

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oratory at Green Lawn, Long Island, with operations scheduled to begin in late summer. A special sonar test facility is being constructed at the laboratory to facilitate the firm's work on electronic anti-submarine warfare equipment. The new lab will adjoin one of the company's manufacturing plants on an 18-acre site.

* * *

RAYTHEON COMPANY will be the new name of the electronics firm formerly known as *Raytheon Manufacturing Company.* This change, voted by stockholders at the annual meeting, became effective in May.

The firm, formerly known as the *American Appliance Company,* was formed in 1922. The *Raytheon* name (which means "Ray of the Gods" in Greek) was adopted in 1925.

* * *

ELECTRONIC INDUSTRY SHOW CORPORATION has designated eight new directors to represent their sponsoring trade associations on the board. They are: Hugh Moore, *Lerco Electronics, Inc.,* representing Western Electronic Manufacturers Association (WEMA); Robert E. Svoboda, *Amphenol-Borg Electronics Corp.,* Association of Electronic Parts and Equipment Manufacturers, Inc. (EP & EM); Robert Ferree, *International Resistance Company,* Producers of Associated Components for Electronics (PACE); Norm Triplett, *The Triplett Electrical Instrument Co.,* Electronic Industries Association (EIA); and Sam Poncher, *Newark Electric Co.;* Joseph S. Forti, *Electronic Wholesalers, Inc.;* William Green, *Electronics Center, Inc.;* and C. T. Kierulff, *Kierulff Electronics, Inc.,* all representing National Electronic Distributors Association (NEDA).

* * *

MILTON R. SCHULTE and **LOUIS RIEBEN** have been elected president and chairman of the board of directors, respectively, of *Tung-Sol Electric Inc.* . . . **TOM SURBER** is now assistant sales manager of the distributor division of *Howard W. Sams & Co., Inc.* . . . **DAVID ALAN SAFER** has been named director of information services of the *CBS Laboratories,* a division of *Columbia Broadcasting System, Inc.* . . . The appointment of **RUSSELL E. CONLEY** as manager, publications advertising and promotion, has been announced by the *Radio Corporation of America* . . . **JAMES R. BOSTWICK** has been named to the newly created post of assistant to the vice-president of *Heath Company.*

* * *

FREDERICK R. LACK, retired vice-president of *Western Electric Company,* has received the electronic industry's 1959 Medal of Honor. It was presented at the 35th national convention of the Electronic Industries Association.

Mr. Lack was responsible for formulating the groundwork which later established the EIA's military products division. He was a director and vice-president of the division from its inception until his retirement. —30—

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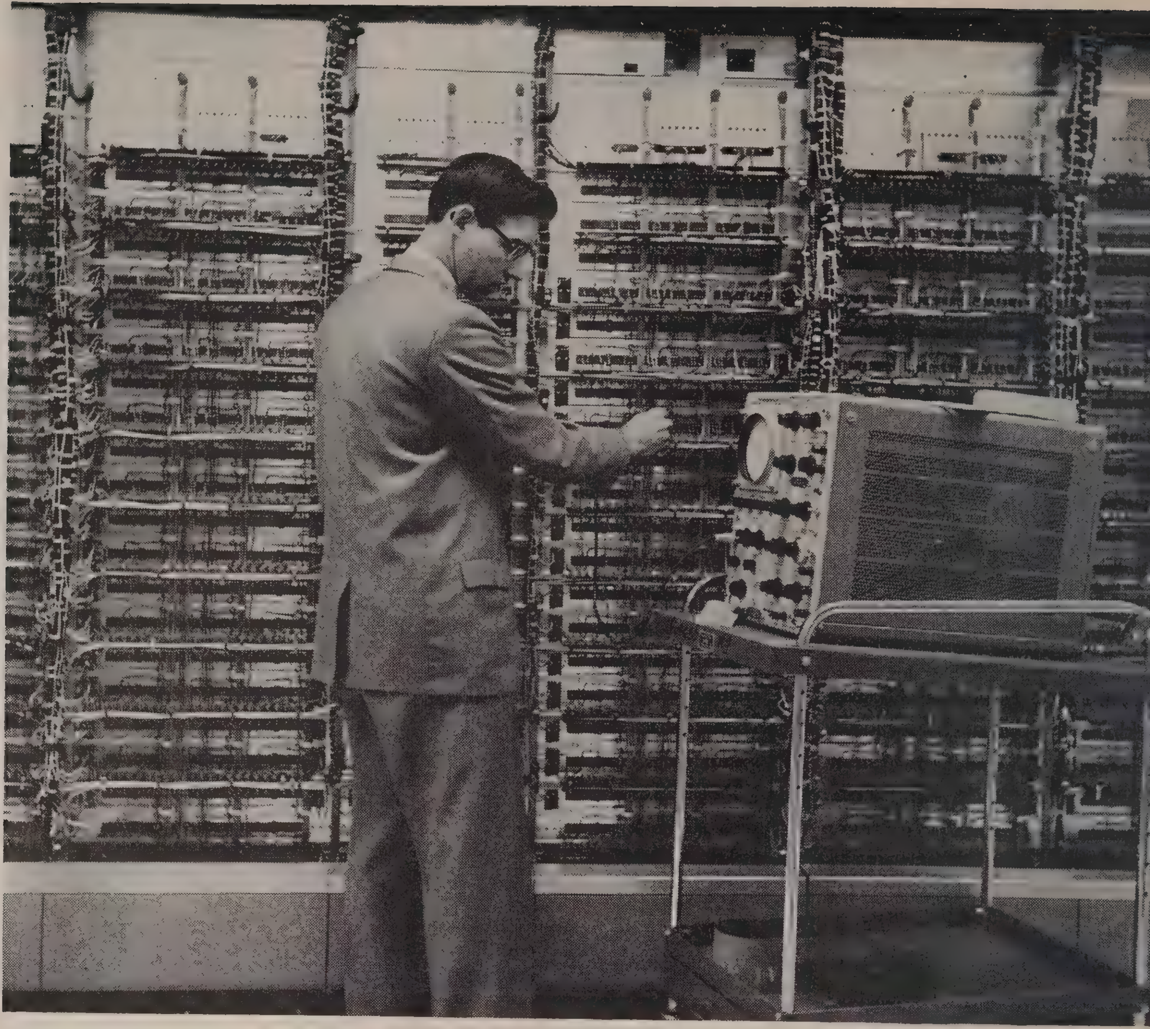

Watching oscilloscope, Bill Wilkerson tests SAGE computer circuitry.

Adjusting SAGE computer operating console.

Bill Wilkerson instructs Field Engineers on new computer program.

How far can you go in electronics . . . without a degree?

Three years ago, young Air Force veteran William H. Wilkerson set out to find a career in electronics, but he had no industrial experience and no engineering degree. Today, he has a solid electronics education, he is supervising the maintenance of a highly advanced electronic computer, and his future is bright. Here's how it happened...

SOUGHT ELECTRONICS CAREER

"I was anxious to go to college when I left the service in 1956," recalls Bill Wilkerson. "The Air Force had given me some fine training in electronics, enough to arouse my interest and make me want to learn a lot more. An engineering education seemed to be the answer, but family responsibilities made college impossible.

"I still wanted to work in electronics, however, so I started looking into technician jobs. Most big companies offered me no more than a seat at a test bench eight hours a day —dull, routine work that provided little or no opportunity to learn and grow. All the interesting assignments, it seemed, called for a college degree. Then I had an interview with IBM and found just what I was looking for in the SAGE Field Engineering Program."

WHAT IS SAGE?

SAGE is a vital part of our country's air defense. To help guard against surprise aerial attacks, SAGE partitions America into several defense sectors. At the heart of each sector is one of the fastest and most reliable electronic computers in the world. This computer receives radar data from many points, checks this against known air traffic in its sector, and makes it possible for Air Force operators manning the computer to identify immediately all flying objects as friendly or hostile. If need be, the computer can also guide a BOMARC missile to an enemy target.

THOROUGH COMPUTER TRAINING

On joining IBM, Bill Wilkerson was given 20 weeks' computer training as a Field Engineer. He learned how to maintain the various electronic units used in a SAGE computing system, how the SAGE computer itself helps diagnose and locate problem areas, and how to make fast, precise repairs without interfering with computer operation. "It was an excellent education—both in the theoretical and practical aspects of electronics," he says. "Furthermore, you have plenty of opportunities to keep up with new developments in this fast-changing field. After assignment to a SAGE site, for example, you may take courses—during regular working hours—on such subjects as improved output methods or new magnetic 'memory' devices. You may also be selected for additional training to learn the total functioning of a large-scale electronic data processing system."

ASSIGNMENTS ROTATED

Bill Wilkerson is now a Field Engineering Group Supervisor at a SAGE site. "I help my Group Manager keep the computer in top working condition," he explains. "Together, we provide technical supervision to the Field Engineers in our group and schedule daily maintenance checks to spot computer problems before they develop into breakdowns. An important part of my job is to make up daily assignment sheets, carefully rotating responsibilities so that each Field Engineer moves from one computer unit to another. This 'cross-training' gives each man a chance to become familiar with all the parts of a large-scale computing system and helps him add to his general electronics knowledge."

RAPID ADVANCEMENT

"When I was first interviewed, I was told that IBM promotes from within," Bill Wilkerson says. "I've found this to be true. In the SAGE computer program, you begin as a Units Field Engineer. Then, depending on your abilities, you can advance rapidly to Systems Field Engineer, Group Supervisor, Group Manager, and on up the line. Every employee receives frequent career counseling to review his progress and to chart his future. In this Company, there are plenty of opportunities for the man who wants to grow and is willing to apply himself."

Bill Wilkerson cites his own career as an example. Since joining IBM three years ago, he's had several promotions, culminating in his present supervisory post. "It's a wide-open field," he says.

A BRIGHT FUTURE

Although other areas for promotion are open to him, Bill Wilkerson would like to stay in technical management because, as he says, "Frankly, I hardly believed back in '56 that a man like myself without a college education could go so far so fast, have still higher goals—and find such solid help in reaching them."

* * * *

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for 20 weeks' training as a computer Units Field Engineer. While training, you receive full pay plus living allowance.

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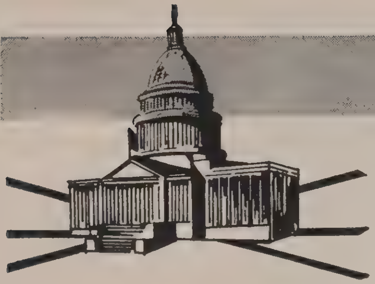

Spot News

Latest Information
on the Electronic Industry

By ELECTRONICS WORLD'S
WASHINGTON EDITOR

MORE ELECTRONIC INVENTIONS WANTED BY ARMED FORCES--An urgent plea for a host of electronic developments, vital to the military, has been made by the National Inventors Council. The Council, composed of distinguished civilian scientists and engineers, and heads of research of the Army, Navy, and Air Force, since 1940 capitalizing on the brainpower of the American public to solve military technical problems, says the Armed Forces now need new techniques in solid-state crystal production, also new types of antennas and components. They want someone to develop a method that will grow germanium and silicon single crystals in ribbons or rods with uniform physical and electrical characteristics to sizes suitable for direct fabrication into diodes, transistors, solar cells, etc. The new approach should permit direct utilization of the semiconductors for device fabrication, thus eliminating the conventional wasteful and expensive slicing, lapping, and polishing operations. Also needed is a new method of electronically (not with frequency change) scanning an antenna, and new types of low-loss, high-power ferrites for use as microwave phase shifters.

BREAKTHROUGH IN MOLECULAR ELECTRONICS REVEALED BY AIR FORCE--An answer, in part, to one of the key problems noted by the Inventors Council--germanium growing--has been announced by the Air Research and Development Command. Two Westinghouse physicists, the statement disclosed, have developed a revolutionary method of growing germanium crystals in thin, uniform flat ribbons, which could lead to the design of outer-space electronic equipment 1000 times smaller and lighter than anything now in existence. Describing the advancement, Colonel C. H. Lewis, Director of ARDC Electronics Directorate, said that the new concept could take the average pocket-sized transistor radio circuitry, excluding the power supply and speaker, down to the size of the head of a match. The breakthrough earned Westinghouse a $2-million development contract in the field of molecular electronics. See page 47 for photo.

ELECTRONIC COMPUTERS TO CONTROL NAVAL ORDNANCE SUPPLIES--Electronics will hereafter control the flow of Naval Ordnance supplies to depots and the fleet. In one area, Mechanicsburg, Pa., a large-scale processing system, heart of which is a Burroughs 220 computer, has begun to provide information on technical records, general inventory control, and shipboard allowance lists, as well as missile inventory, provisioning, and price changes. Elsewhere, the Navy has contracted with Remington Rand for the production of $11-million worth of advanced transistorized shipboard computing systems. Equipment will feature a memory section with a capacity of 983,040 binary digits. And to keep track of its missiles and ammunition throughout the world, the Navy will use still another electronic computing method, devised by the Bureau of Ordnance--an all-transistor, high-speed data-processing system developed by RCA. As the initial step in a five-phase logistics program, the system is expected to provide high-speed inventory control of missiles, mines, torpedoes, bombs, and bullets from the production line until they are expended.

THIRD-DIMENSION--ALTITUDE INFORMATION--TO BE ADDED TO RADAR--A radar system that will automatically add altitude--the third dimension--to the present two-dimensions--distance and bearing--and thus provide accurate height information on aircraft up to a range of 50 nautical miles, is now being developed, according to the Federal Aviation Agency. The system, known as Air Height Surveillance Radar (AHSR-1), will use a three-sided antenna, 500-feet high, with each of the three sides 60-feet wide.

ULTRASONIC MICROSCOPE THAT "SEES" SOUND DEVELOPED--An ultrasonic-absorption microscope using sound to see minute structures in living cells and tissues has been developed by Drs. Floyd Dunn and William Fry of the University of Illinois. The device features a vibrating quartz crystal to generate high-frequency sound waves, a coupling liquid that transmits waves through and around material under examination, and, to detect absorption of sound through the specimen, a thermo-electric probe is used. The ingenious tool is expected to provide information that light and electron microscopes cannot deliver since sound waves interact in a different manner with tissues than either electrons or light waves.

—30—

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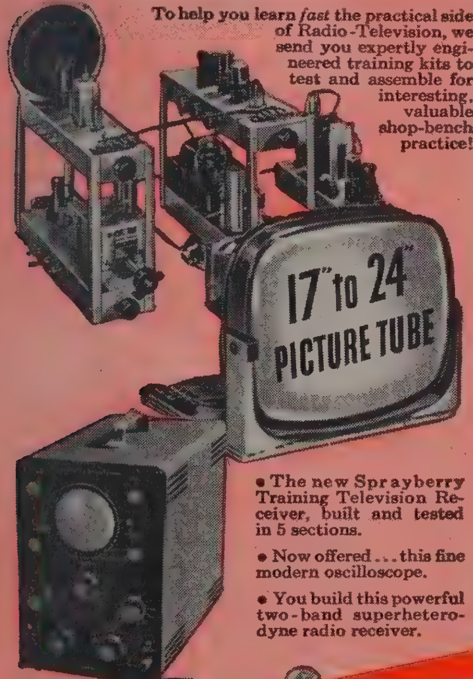

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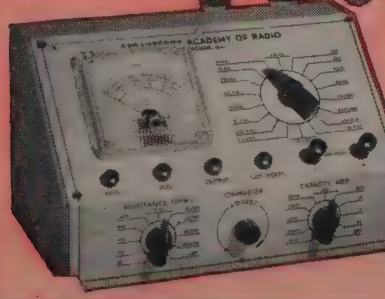

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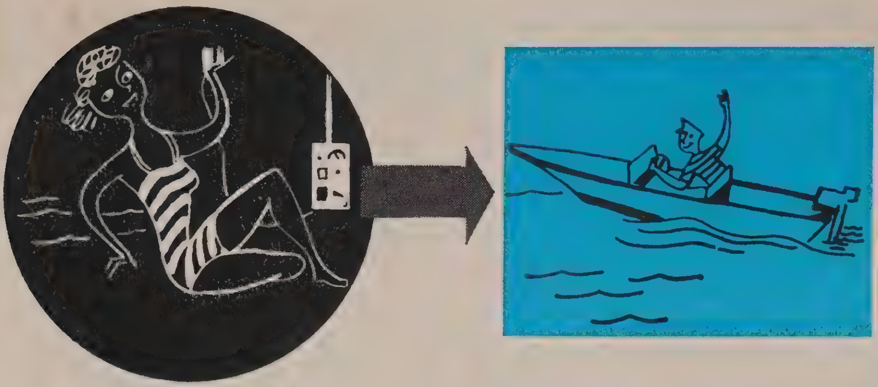

How much do you know about the new class D citizens band?

■ Just what is the purpose of the new Class D Citizens Band service? ■ Can you use it for business or commercial purposes? ■ What are the license requirements? ■ Can you operate at a fixed location? ■ Is it possible to change your frequency? ■ Can you call unknown stations at random?

These and many other questions about the new Citizens Band are fired at the Federal Communications Commission next month in ELECTRONICS WORLD—and you'll find all the answers right at your finger tips.

This important question and answer session with the FCC is typical of the authoritative and informative articles that await you in September's big ELECTRONICS WORLD. You'll also be interested in such pertinent articles as:

CAREER OPPORTUNITIES IN ELECTRONICS

Industry-wide survey of openings for non-graduate engineers and technicians—rundown on positions available, salaries, tips on affiliated fields, training needed...all you need to know about finding a spot for yourself in this ever-changing field.

MORE EFFICIENT HAM OPERATION WITH THE SINGLE SIDEBAND

First of an authoritative two-part series on the Single Sideband for the Ham—you'll find a complete rundown on basic principles—its advantages and how to suppress the carrier signal.

BUILDING A COMPACT TWO-TUBE STEREO AMPLIFIER

Construction details on a stereo amplifier that uses only two tubes and requires no power transformer...designed around CBS' new 50FY8 audio tube.

DESIGNING YOUR OWN SPEAKER ENCLOSURES WITH BASS-REFLEX CHARTS

Here's complete data—in a fold-out, two color chart—for the audiophile who wants to design speaker enclosures suitable for speakers from 5″ to 18″ in diameter. Complete explanatory material—plus information on actual construction material and acoustical lining.

Next month's ELECTRONICS WORLD is typical of the coverage you'll enjoy month after month in the world's most authoritative electronics magazine. Be sure of getting your copy—every month—by subscribing now. The newsstand price of ELECTRONICS WORLD is now 50¢ and subscription rates will be increased soon. So act now to take advantage of the present low rates. Subscribe today!

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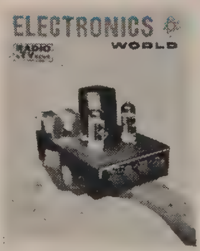

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CREI students (more than 17,000 are currently enrolled) keep pace with the electronics industry and are eagerly sought by employers who offer solid opportunities for rapid advancement.

Paul S. Lewis, Jr., a research assistant in an AEC-sponsored nuclear physics research program—and a CREI student—writes, "Like most large-scale physics projects, this machine (a proton accelerator) is largely electronic. The need for electronics technicians on basic scientific research projects will no doubt continue to grow."

Residence School in Washington, D. C.

Charles E. Lawson, another CREI student, brings out another point: "The fact that I am enrolled with CREI was met with enthusiasm on the part of my employer, Wright Airborne Electronics. A former student of CREI is now chief engineer for the company."

CREI home study can modernize your electronics education and keep it up to date. If you have had basic electronics training with practical experience in electronics, and a high school education, you can probably qualify for CREI education—**applied** electronic engineering technology.

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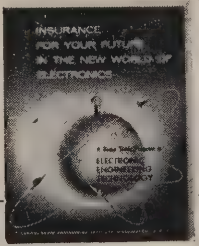

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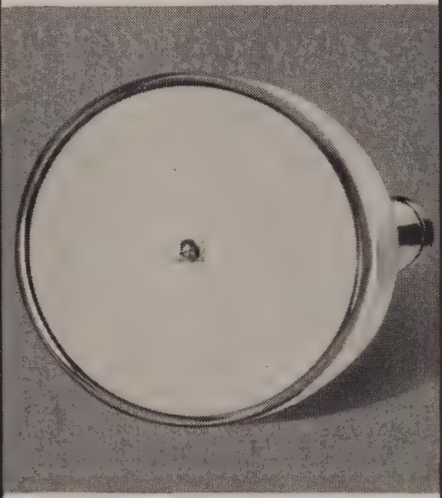

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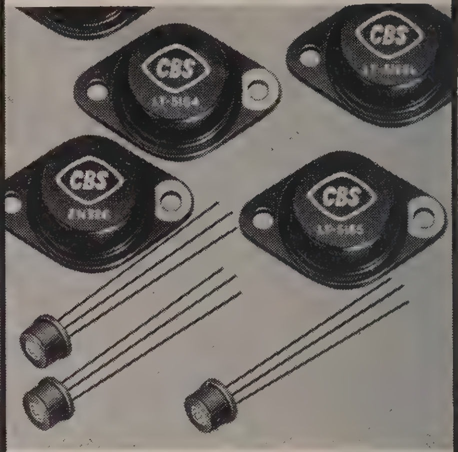

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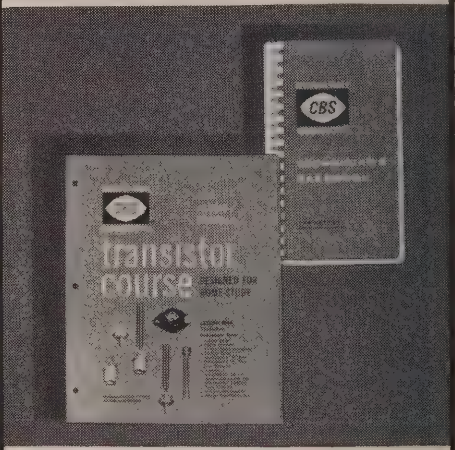

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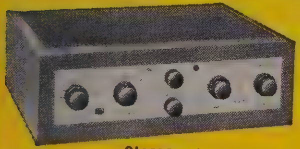
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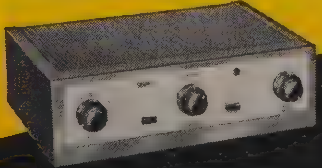
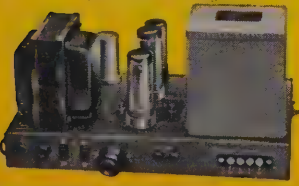

Monaural Preamplifiers: HF65, HF65A (stack 2 for Stereo)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NEW STEREOPHONIC EQUIPMENT

NEW AF-4 Complete Stereo Dual Amplifier (not illus.) provides **clean** 4W per channel or 8W output. Usual solid EICO construction & trouble-free design. Inputs for ceramic/crystal stereo pickups, AM-FM stereo, FM-Multi stereo; 6-position stereo/mono mode selector: clutch-concentric level & tone controls. 27db of feedback around each power amplifier reduces distortion to 0.3% at normal listening levels with hi-efficiency speakers (Norelco AD4877M or equivalent recommended). Kit **$38.95.** Wired. **$64.95.**

HF85: Stereo Dual Preamplifier is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifies, controls any stereo source — tape, discs, broadcasts. Superb variable crossover, feedback tone controls driven by feedback amplifier pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate lo-level input in each channel for mag. phono, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiplex. One each auxiliary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function Selector permits hearing each stereo channel individually, and reversing them; also use of unit for stereo or monophonic play. Full-wave rectifier tube power supply. 5-12AX7/ECC83, 1-6X4. Works with any high-quality stereo power amplifier such as EICO HF86, or any 2 high quality mono power amplifiers such as EICO HF14, HF22, HF30, HF35, HF50, HF60. **"Extreme flexibility . . . a bargain"** — HI-FI REVIEW. Kit **$39.95.** Wired **$64.95.** Includes cover.

HF86: Stereo Dual Power Amplifier for use with HF85 above or any good self-powered stereo preamp. Identical Williamson-type push-pull EL84 power amplifiers, conservatively rated at 14W, may be operated in parallel to deliver 28W for non-stereo use. Either input can be made common for both amplifiers by Service Selector switch. Voltage amplifier & split-load phase inverter circuitry feature EICO-developed 12DW7 audio tube for significantly better performance. Kit **$43.95.** Wired **$74.95.**

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source -- tape, discs, broadcasts & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. **"Excellent"**—SATURDAY REVIEW; HI-FI MUSIC AT HOME. **"Outstanding quality . . . extremely versatile"** -- RADIO & TV NEWS LAB-TESTED. Kit **$69.95.** Wired **$109.95.** Includes cover.

MONO PREAMPLIFIERS (stack 2 for STEREO)

HF-65: superb new design. Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95.** Wired **$44.95. HF65** (with power supply) Kit **$33.95.** Wired **$49.95.**

MONO POWER AMPLIFIERS (use 2 for STEREO)

HF60 (60W), HF50 (50W), HF35 (35W), HF30 (30W), HF22 (22W), HF14 (14W): from Kit **$23.50.** Wired **$41.50.**

MONO INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52 (50W), HF32 (30W), HF20 (20W), HF12 (12W): from Kit **$34.95.** Wired **$57.95.**

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". **"Eminently musical"**—Holt, HIGH FIDELITY. **"Fine for stereo"**—MODERN HI-FI. Completely factory-built: Mahogany or Walnut, **$139.95;** Blonde, **$144.95.**

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD 11" x 23" x 9". Wiring time 15 min. Price **$39.95. LGS-1 Brass Tip Matching 14" Legs** easily convert HFS-1 into attractive consolette. All brackets & hardware provided. **$3.95.**

FM TUNER HFT90: A superior **stable** tuner easy to assemble — no instruments needed. Prewired, prealigned, temperature-compensated "front end" is **drift-free,** eliminates need for AFC. Prewired exclusive precision **eye-tronic**® traveling tuning indicator contracts at exact center of FM channels. Prealigned IF coils. Sensitivity 6X that of other kit tuners: 1.5uv for 20db quieting; 2.5uv for 30db quieting, full limiting from 25uv. IF bandwidth 260kc at 6db points. Frequency response 20-20,000 cps ±1db. 2 output jacks: cathode follower to amplifier, Multiplex output for FM Multiplex Stereo adapter; thus prevents obsolescence. Very low distortion. **"One of the best buys in high fidelity kits"** — AUDIOCRAFT. Kit **$39.95*.** Wired **$65.95*.** Cover $3.95.

*LESS COVER, F.E.T. INCL

NEW AM TUNER HFT94: Matches HFT90. Selects "hi-fi" wide (20c — 9kc @ −3 db) or weak-station narrow (20c — 5kc @ −3 db) bandpass. Tuned RF stage for high selectivity & sensitivity; precision **eye-tronic**® tuning. Built-in ferrite loop, prealigned RF & IF coils. Sensitivity 3 uv @ 30% mod. for 1.0 V out, 20 db S/N. Very low noise & distortion. High-Q 10 kc whistle filter. Kit **$39.95.** Wired **$69.95.** Prices incl. Cover & F.E.T.

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for COLOR & Monochrome TV servicing

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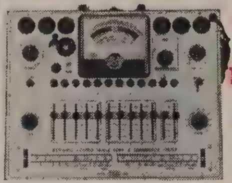
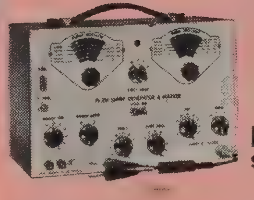


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

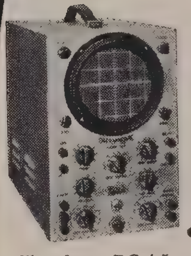
SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication** of Gm, Gp & peak emission. **Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**



NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased **incereductor** for excellent linearity. **Extremely flat RF output: new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **3 fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.



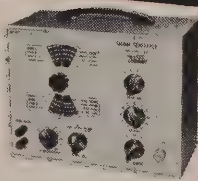
COLOR and Monochrome DC to 5 MC LAB & TV 5″ OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

- Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

5″ PUSH-PULL Oscilloscope #425: Kit $44.95, Wired $79.95.
7″ PUSH-PULL Oscilloscope #470: Kit $79.95, Wired $129.50.



NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower for** improved mod. **Variable depth of int. mod. 0-50%** by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

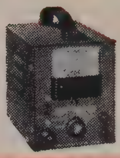
Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

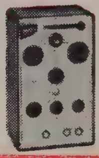
Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½″ meter, can't burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

NEW 6-TRANSISTOR PORTABLE RADIO RA-6
KIT $29.95
Wired $49.95
includes leatherette case
F.E.T.; less 9V battery

All U.S.-made. Highly sensitive, selective. Prealigned RF, IF xfmrs; push-pull audio; 6″ oval PM speaker

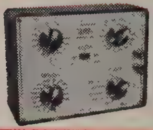


NEW Power & Bias Supply for Transistorized Eqpt, #1020
Kit $19.95 Wired $27.95

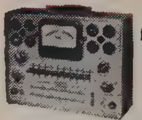


NEW TUBE & CRT FIL. Tester #612
Kit $3.95 Wired $5.95

Fast-checks radio/TV tubes, pilot lamps, etc.



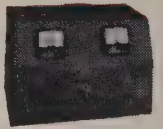
Series/Parallel R-C COMBINATION BOX #1140
KIT $13.95
WIRED $19.95



TUBE TESTER #625
KIT $34.95 Wired $49.95

- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter................$4.50



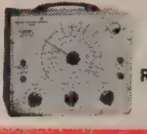
6V & 12V BATTERY ELIMINATOR & CHARGER #1050
KIT $29.95
WIRED $38.95

Extra-filtered for transistor equipt.

#1060 KIT $38.95
WIRED $47.95

20,000 Ohms/Volt V-O-M #565
KIT $24.95 Wired $29.95

1000 Ohms/Volt V-O-M #536
KIT $12.90
Wired $14.90



R-C BRIDGE & R-C-L COMPARATOR #950B
KIT $19.95
Wired $29.95

Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd, power factor

VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

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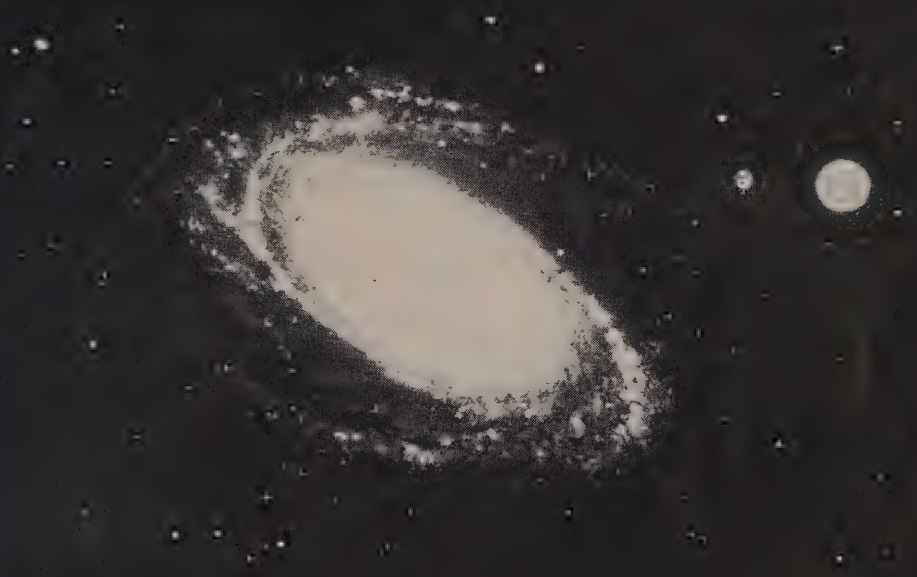
ELECTRONICS IN OUTER SPACE



Part 1. The electronics payload in our satellites and space probes and how this equipment keeps us in touch with the satellite and with its discoveries.

By **JORDAN McQUAY**

IN mankind's continuing search and exploration of the vast regions of the earth's atmosphere and the even greater regions of outer space, electronics has assumed significant stature — both as a science and a technology. For only through electronics can we learn directly of the hitherto unknown mysteries of the surrounding universe — and beyond.

Giant strides have been taken within the past two years, with the successful launching of satellites that orbit the earth as well as long-range space vehicles that probe the vastness beyond our atmosphere. And with each successful launching, mankind learns more and more about outer space.

This knowledge is obtained through multiple uses of electronics — ranging from sensitive sensory devices through elaborate electronic instrumentation, and utilizing radio, television, and allied branches of the science and technology of electronics.

An integral part of every satellite and space probe is the assembly of sensory units, telemetry converters, radio transmitters and receivers, and other equipment — known as *the electronics payload.*

A current chart of all earth satellites and space probes launched successfully by the United States and Russia is shown in Table 1. Arranged chronologically, the chart reveals comparative data particularly concerning each electronics payload.

These are the first satellites, the first space probes. Through scientific experience, more refined and sophisticated space vehicles will emerge during future months and years — each with a precious cargo: its electronics payload.

This series of articles is a general review of the important types of electronic devices and instrumentation that have been used successfully and that will be used in future launchings of satellites and space probes. No attempt is made to describe every detail of every space vehicle — but to cover major, significant kinds of sensory units, telemetry converters, data storage, radio transmission, and other components of the electronics payloads of satellites and space vehicles *while in flight.*

Most of the equipment has been proven under actual operating conditions — aboard "Explorer," "Vanguard," "Pioneer," "Discoverer," and other types of space vehicles. A few of the electronic devices will be used aboard *future* satellites and space probes yet to be launched.

Failure of some of the early "Vanguard" satellites, during 1958, does not mean that the electronics payloads have been abandoned. All of these will ultimately see service aboard other space vehicles.

Even when satellites fall back toward earth and disintegrate in our upper atmosphere, they still provide some new and hitherto unknown data. Even when space probes disappear millions of miles away and beyond any known range of communication, they provide new and important glimpses of the vast universe that surrounds our relatively infinitesimal planet called earth.

Charting the Unknown

Once in orbit around the earth or moving outward in space, what can a space vehicle provide? What new physical, scientific, or technical data?

Depending upon its type of electronic instrumentation, a space vehicle is an invaluable source of data concerning the upper atmosphere and outer space, which can't be obtained in any other way or by any other means.

As a research tool, a space vehicle provides measurements over a fairly long period of time without interference of the lower atmosphere—which is like a constraining blanket around the earth. Through its electronics payload, such a vehicle provides knowledge of the upper atmosphere—its structure, its constituents, and the powerful radiations that are forever present.

About the atmosphere: density, temperature, pressure.

About the ionosphere, thermosphere, exosphere.

About cosmic rays, and solar electromagnetic radiation—and its effect on radio propagation for long-distance radio communications.

Many of the environmental and other space measurements and experiments to be described have been completed. Others will be completed during 1959 and 1960—usually as part of publicized satellite or space probe launchings, but sometimes of a military nature and both unpublicized and unannounced. Launchings are controlled and supervised by two government agencies: NASA (National Aeronautics and Space Administration) for civilian or non-military flights and ARPA (Advanced Research Projects Agency, Department of Defense) for military space endeavors.

To date, American successes and failures have generally been public knowledge because they have been part of the International Geophysical Year and usually non-military. No attempt was ever made by this country to effect a shotgun marriage between civilian scientists and the military—as in Russia.

As a result, American work in satellites and space probes has been conducted largely in a goldfish bowl, for all to see—while Russia works in secrecy. With expansion and greater diversification of space effort by the United States, some types of space work probably will *not* be made known publicly—whether successes or failures—in the interests of national security.

But, generally speaking, such classified space experiments and developments will utilize the basic types of electronic instrumentation described in these articles. Most of this work in the immediate future will be confined to improving space vehicles—to carry larger and more sophisticated electronics payloads into space.

To launch any space vehicle, sufficient thrust or potential energy must be applied to raise the vehicle at least 300 miles above the earth's surface—and *then* impart sufficient kinetic energy so that its velocity will overcome the attraction of the earth's gravity.

What keeps our moon in orbit is its velocity around the earth. It also keeps the earth in a stable orbit around the sun. An earth satellite is the same thing, on a much smaller scale.

Most of the weight is in the missile. The electronics payload of a space vehicle is usually a small percentage of the weight and volume of the entire launching device. The payload is frequently only a few hundred pounds in weight, compared to ten or twenty tons for the actual missile.

Once in space, the environmental conditions are extremely rugged—and virtually unknown. The space vehicle accelerates rapidly to the fastest velocity ever attained by a man-made object—nearly 20,000 miles an hour, or 333 miles a minute. Rising from a sea-level launching site to the immense vacuum of outer space, a space vehicle encounters wide ranges in air temperature, air pressure, and aerodynamic friction all along the way.

The Payload

The principal purpose of launching any satellite or space probe is to place a specific type of electronics payload in space where it can make environmental or other measurements, and perform communications, television, or other experiments associated with outer space.

Through electronics, various data is collected in space, converted to signal impulses, and telemetered to ground receiving stations on earth. Through electronics, the payload can be designed to function as a radio-relay station in outer space. Through electronics, visual pictures of the earth and other planets can be obtained by television equipment. Through electronics, space vehicles can explore the unknown reaches of outer space, and can utilize this vast area of space for a variety of peaceful as well as military purposes.

These are the important roles of elec-

(*Continued on page* 38)

Fig. 1. Here is the electronics payload of "Vanguard II," the weather satellite.

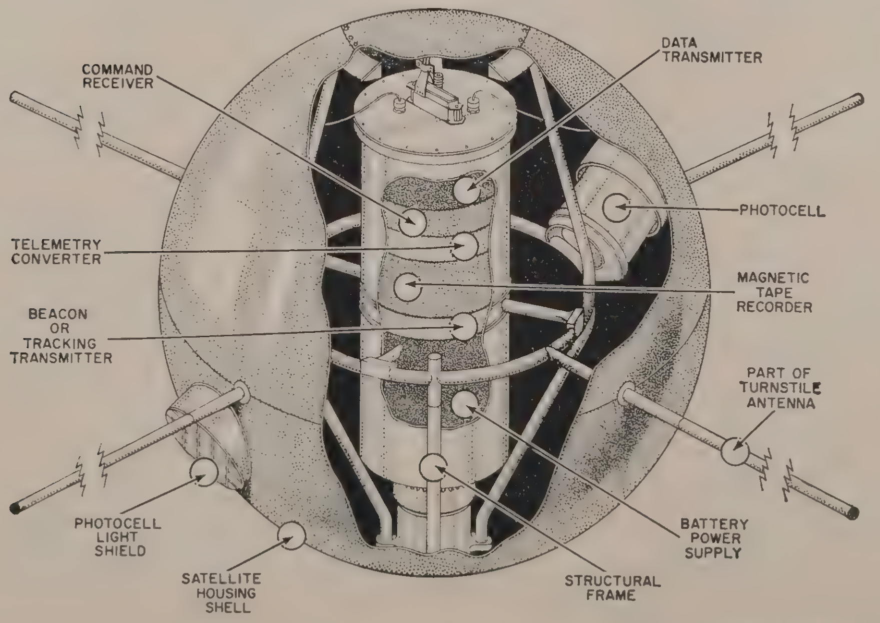
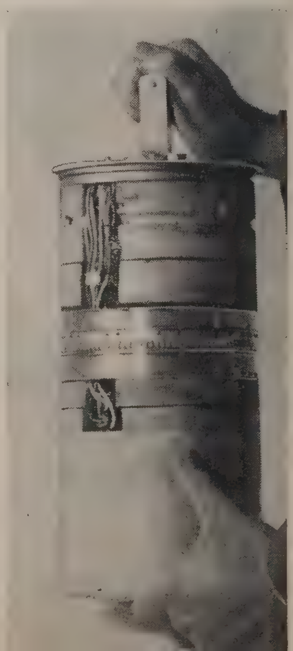


Fig. 2. Here is a photo of the package of electronics gear used in "Vanguard II."



RECENT SATELLITES & SPACE PROBES

	SPUTNIK I	SPUTNIK II	EXPLORER I	VANGUARD I	EXPLORER III	SPUTNIK III	EXPLORER IV	PIONEER I	PIONEER III	Project SCORE	MECHTA (cosmic rocket)	VANGUARD II	DISCOVERER I	PIONEER IV	DISCOVERER II
LAUNCHED	Oct. 4 '57	Nov. 3 '57	Jan. 31 '58	Mar. 17 '58	Mar. 26 '58	May 15 '58	Jul. 26 '58	Oct. 11 '58	Dec. 6 '58	Dec. 18 '58	Jan. 2 '59	Feb. 17 '59	Feb. 28 '59	Mar. 3 '59	Apr. 13 '59
PAYLOAD WEIGHT	184 lb.	Unknown	30.8 lb.	3.25 lb.	31 lb.	Unknown	38.5 lb.	84 lb.	84 lb.	150 lb.	796 lb.	21.5 lb.	40 lb.	13.4 lb.	160 lb.
EXPERIMENT MEASUREMENT	Internal temperature. Air pressure	Radiation Internal temperature Pressure (Dog)	Radiation Air temp. Meteorites	Air temp.	Radiation Air temp. Meteorites	Radiation Meteorites	Radiation	Radiation Air temp. Meteorites	Radiation Air temp. Meteorites Magnetic fields	Temperature Communication relay	Unknown	Cloud distribution (weather)	Test propulsion, guidance systems (for use in future)	Radiation Meteorites	Radiation Re-entry
RADIO TRANSMITTERS	20.005 mc. (data) 40.002 mc. (data)	20.005 mc. (data) 40.002 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	20.005 mc. (data) 40.002 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	108.00 mc. (tracking) 108.06 mc. (data)	108.00 mc. (tracking) 960.05 mc. (data)	108.00 mc. (tracking) 132.00 mc. (messages)	19.993 mc. 19.995 mc. (data) 183.6 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	108.00 mc. (tracking) 108.03 mc. (data)	108.00 mc. (tracking) 960.05 mc. (data)	
POWER SUPPLY	Chemical batteries	Chemical batteries	Mercury batteries	Mercury batteries plus solar cells	Mercury batteries	Chemical batteries plus solar cells	Mercury batteries	Mercury batteries	Mercury batteries	Mercury batteries	Chemical batteries	Mercury batteries	Mercury batteries	Mercury batteries	
RADIO LIFETIME	23 days	7 days	Tr: 2 wks. Da: 4 mos.	Tr: 2 wks. Data: indefinitely	Tr: 2 mos. Da: 2 mos.	1 mo.	2 mos.	1 day	1 day	12 days	3 days	Tr: 4 wks. Da: 2 wks.	8 days	4 days	
SATELLITE or SPACE PROBE LIFETIME	3 months Died: Jan. 4 '58	5.5 mos. Died: Apr. 13 '58	3 to 5 years*	200 years*	3 months Died: Jun. 28 '58	Unknown*	Unknown*	1 day Died: Oct. 12 '58	1 day Died: Dec. 7 '58	Unknown	Unknown**	Unknown*	Unknown	Unknown**	14 days Died: Apr. 27 '59

*Now orbiting earth
**Now orbiting sun

Table 1. Recent satellites and space probes. Information on their electronics payloads.

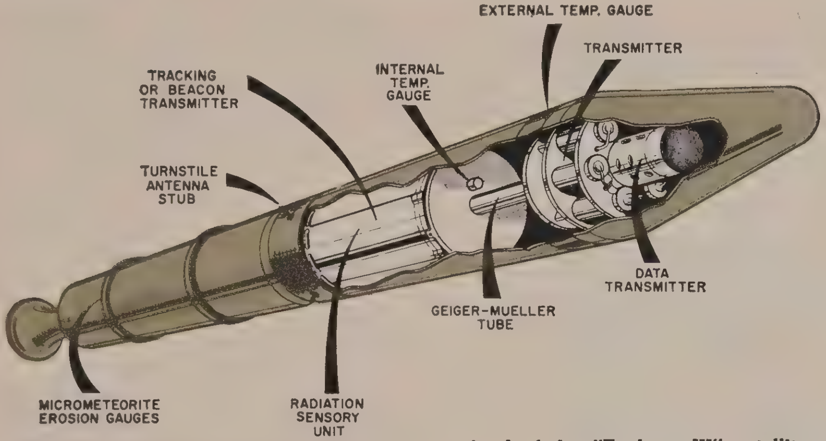

EXTERNAL TEMP. GAUGE
TRANSMITTER
TRACKING OR BEACON TRANSMITTER
INTERNAL TEMP. GAUGE
TURNSTILE ANTENNA STUB
DATA TRANSMITTER
GEIGER-MUELLER TUBE
MICROMETEORITE EROSION GAUGES
RADIATION SENSORY UNIT

Fig. 3. Drawing showing the electronics payload of the "Explorer III" satellite.

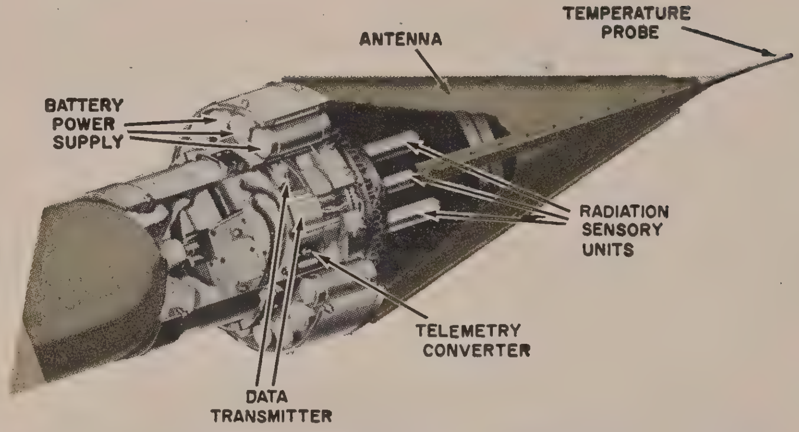

TEMPERATURE PROBE
ANTENNA
BATTERY POWER SUPPLY
RADIATION SENSORY UNITS
TELEMETRY CONVERTER
DATA TRANSMITTER

Fig. 4. The electronics equipment employed for "Pioneer III" is shown here.

tronics in space—tasks that were considered impossible less than ten years ago, now accomplished by a diminutive but important electronics payload aboard a satellite or space probe.

Since the payload must be adapted physically to the shape and size of a missile, there is considerable variance in the arrangement of the components that constitute the electronics payload.

The first American satellite—"Vanguard I"—was confined within a tiny 6-inch spherical shell. A larger sphere, about 20 inches in diameter, housed the payload of "Vanguard II," called the weather satellite (Fig. 1).

A more typical arrangement is the payload of "Explorer III" (Fig. 3), which is instrumented primarily for cosmic-ray detection and measurement. This is somewhat similar to the first Russian satellite—the "Sputnik I."

A more sophisticated electronics payload aboard the "Pioneer III" (Fig. 4) provides a variety of measurements.

Inclusion of additional measuring devices—as well as animals and even human beings—demands a much larger missile, which only Russia has succeeded in developing, due to advances in the techniques of missile launching.

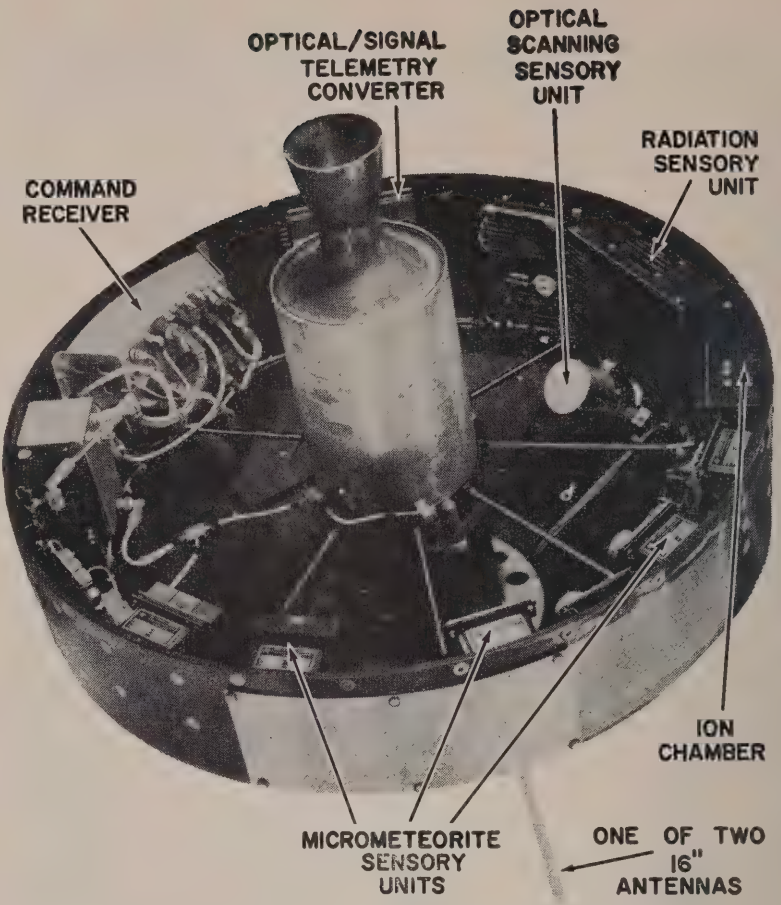

OPTICAL/SIGNAL TELEMETRY CONVERTER
OPTICAL SCANNING SENSORY UNIT
RADIATION SENSORY UNIT
COMMAND RECEIVER
ION CHAMBER
MICROMETEORITE SENSORY UNITS
ONE OF TWO 16" ANTENNAS

Fig. 5. Photograph of the electronics payload that is employed in "Pioneer I."

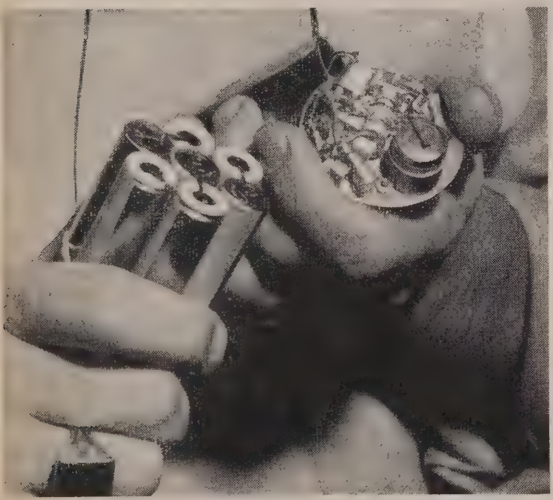


Fig. 6. Beacon or tracking transmitter with mercury battery power supply (left).

All electronics payloads consist essentially of three parts: 1. Radio facilities for tracking and for data telemetry to earth; 2. Facilities for data instrumentation and/or special communications and television experiments; 3. Power supplies.

The U. S. satellites and space probes are equipped with a low-power beacon or tracking transmitter which broadcasts a continuous signal on 108.00 mc. to enable ground stations to track the passage of the space vehicle.

Sometimes telemetered data—such as temperature, radiation, etc.—is also broadcast by the beacon or tracking transmitter, by frequency modulation of the 108.00 mc. carrier.

Most of the scientific data measured or obtained by sensory units is fed separately into conventional telemetry equipment, which converts the information into a signal of coded impulses. In analogue form, the telemetry signal is in the audio-frequency range, seldom exceeding about 13 kc. This signal modulates a second radio transmitter aboard the space vehicle, which operates on a different frequency from the beacon transmitter—usually with higher power. This is known as the data transmitter.

Russian satellites and space probes use from two to five radio transmitters, all of them broadcasting data to their ground receiving stations. Russian satellites generally operate on 20 mc. and 40 mc.

Sometimes magnetic recorders are included in the electronics payload and special equipment is utilized for radio-relay communications and for televisual operations.

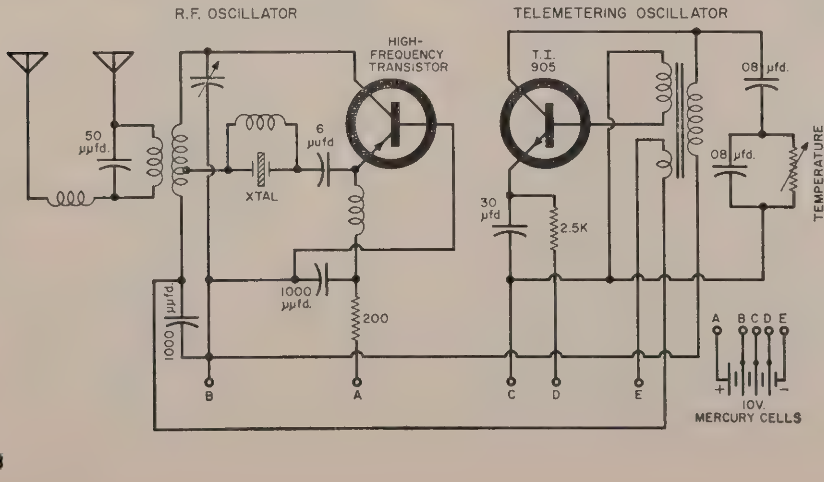
The Russian space probe—"Mechta" —expelled a sodium cloud periodically as a means of checking the path of the vehicle. The main unit was a sodium evaporator, which was switched on and off by a simple electronic clock after the probe reached an altitude of about 75,000 miles.

All electronic equipment within the payload of a satellite or space probe is powered by storage batteries, by storage batteries charged with solar cells, or by solar cells alone.

A complete electronics payload—sensory units, transmitters, and power supply—is shock mounted in a pressure-tight chamber and the payload is

(*Continued on page* 124)

Fig. 7. Circuit diagram of the beacon transmitter with a telemetering oscillator.



Shopping for a Hi-Fi Amplifier

By **NORMAN H. CROWHURST**

What to look for in a hi-fi amplifier. Discussion of some amplifier specifications and what they mean.

SOME people will tell you that all good hi-fi amplifiers are alike; that amplifiers are the strongest link in the audio chain and, as long as you have a good loudspeaker, pickup, tape recorder, etc., any *good* amplifier will do. But this just isn't true. Despite the fact that, according to their specifications, you should not be able to hear a difference between individual amplifiers, the fact remains that you can. This being the case, the newcomer to high-fidelity definitely needs advice on how to shop for a hi-fi amplifier.

One of the early questions usually is, "Do I need a separate preamplifier or should I buy one of the combined units?" At one time this would have been principally a "quality" question. If you really wanted the best, the separate preamplifier and amplifier certainly gave you the best chance of obtaining good quality. For one thing the hum and noise level was likely to be much lower in separate units than it was in a single combined unit.

However, good engineering work has resulted in some of the combined units giving performance equal to that of the separate units and there is a considerable cost saving. So, nowadays, as far as the quality aspect of the choice is concerned, you must judge the individual unit. But there is still another question that may help you to decide which is the best choice for you.

The single unit job puts all your eggs in one basket, so to speak. If you later need more power than provided by the amplifier you first buy, you have to purchase another complete unit. Buying a separate preamplifier and power amplifier enables you to keep the preamplifier part when you need more power, merely buying a larger power amplifier. So, if you are quite sure that a 25-watt amplifier is big enough, your best buy will probably be the combined unit. But if you feel that a 25-watt amplifier is big enough for now but later on you may want a higher powered system, then you'd better buy separate units.

How Much Power?

This naturally leads into the second question, "How much power do I need? How am I to know whether I need a 15-, 25-, 30-, 50-, or 70-watt amplifier?" On this subject many conflicting views have been expressed.

Some writers will say that nobody ever needs more than a 15-watt amplifier, that the greatest average power you will need in a living room is about 1 watt, and 15 watts is plenty to handle the occasional peaks that come along. Another writer will say that, to have adequate margin to handle the high power peaks, you definitely need 50 watts or more.

As so often happens when conflicting statements are made, both of them *may* be true. It depends on circumstances. To appreciate this, we must learn to think of power in db units rather than in watts. A change in level of 1 db can just be heard by careful listening when the level is changed by a key switch with a steady tone playing. Changing the level by 3 db fairly rapidly but smoothly makes a barely audible difference. A change of level of 10 db (which was originally defined as one Bel) is about the smallest unit of loudness change that can be unmistakably identified.

Translating this information into watts, what do we have? If we start with an arbitrary loudness, represented by an average power of 1 watt, increasing the average power to 10 watts represents one recognizable step louder, while increasing it to 100 watts represents two recognizable steps louder. In point of fact, after listening for a while, *if the 100-watt power level is undistorted,* the hearing faculty becomes accustomed to it, so you may cease to be conscious of the fact that it is any louder than the previous 1-watt listening level.

This fact is partially responsible for the way many high-fidelity fans end up playing their equipment at a level approaching 100-watts! Although it may not seem to make that much difference, listening in the same room, it makes a considerable difference to neighbors and other people in the locality. While the 1-watt listening level is just comfortable in the living room and barely audible next door, the 100-watt listening level may still be just comfortable in the same room but quite audible in the next street. So we respectfully suggest that those who like a 100-watt listening level consider how close their neighbors live—if they want to be good neighbors.

But there are other factors that enter into the determination of amplifier power needs. One thing is the fact that not all loudspeakers deliver the same amount of sound for the same electrical power from the amplifier. Loudspeaker efficiencies vary. Units such as the acoustic suspension, or AR type, are relatively inefficient, while horn-loaded loudspeakers using effective drive units can be highly efficient. This can make a difference of at least 10 to 1 in the *electrical* power from the amplifier needed to produce the same *acoustic* power.

Other factors that can produce almost identical differences in apparent loudness, are the size and way a room is furnished and the ambient background level (that is, whether you happen to live near a railroad track or in a quiet country neighborhood). If you have the most efficient possible loudspeaker in a quiet background and good acoustic surroundings, probably all you need is a fraction of a watt to get satisfactory listening.

On the other hand, if you have an inefficient loudspeaker in a listening room which is highly absorbent acoustically and with an extremely noisy background, you might need 100 watts of sound to make the level correspondingly "comfortable." The difficulty would be in finding a loudspeaker that would handle this much power. This brings up another point with respect to power.

Amplifier Distortion

Loudness is often judged not so much by the actual sound level as by the point where distortion begins. In the old days of battery tubes, when 250 milliwatts (a quarter of a watt) was "high" power, a set sounded loud when distortion came in. Later on, with more efficient loudspeakers and amplifiers capable of 15 watts or more output, operating at 10 times the 250 milliwatt level did not sound nearly as loud because they were relatively free from distortion.

This is another reason why people with high-power amplifiers tend to operate them at a high level. Operated at a low level they never sound loud, however much sound output they may be producing. The fact remains, however, that to appreciate high-fidelity we do need to operate below the distortion point and hence it is not desirable that the reproduction should sound loud in the sense of producing distortion.

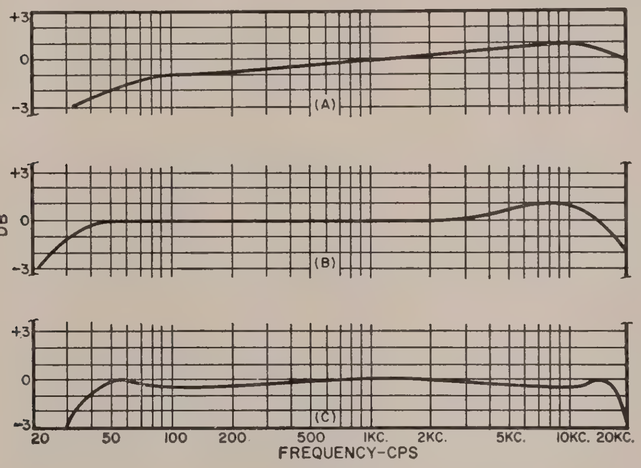


Fig. 1. Which of these amplifier responses would sound best? (A) has the widest deviation between certain frequencies but this amplifier would probably sound better than the other two. (B) shows the same difference between response at 1 kc. and 10 kc. as does (A), but it takes the form of a peak, which is far more audible. (C) shows even smaller deviations, where peaks have been used to "hold up" the response. This amplifier may sound even more colored than does (B), especially since the regions of sharp cut-off are inside the audio range used.

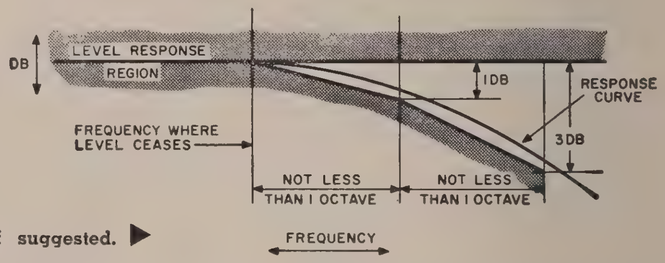


Fig. 2. Illustrating the rule for rate of roll-off suggested.

There is still another important aspect to the amplifier power question: its power rating is very far from being the whole story in this direction. Making a direct comparison between, say, a very good 15-watt amplifier and a mediocre 50-watt amplfiier, using the same front-end (pickup and preamplifier or tuner) and loudspeaker system, it is possible that the 15-watt amplifier will seem to deliver more undistorted output than the 50-watt amplifier. This is explained by the way the amplifier overloads. What happens when the top of its undistorted power range is reached?

In most musical programs there are occasional peaks which shoot at least 10 times above the average power level of the program, sometimes 100 times or more. These occasional peaks are of such short duration that distortion *only* for this moment requires extremely careful listening to identify. If it does not produce any distortion in the program that immediately follows the peak the distortion may pass unnoticed. But some amplifiers are thrown momentarily off balance by this short-duration distortion so as to continue distorting the program that immediately follows. The only way to judge is to listen to individual amplifiers on practical program material, not depending on measurements or specifications alone.

Frequency Response

Next we come to the question of frequency response. Many amplifier specifications quote frequency response in some way or another because this is recognized as one of the important criteria of high-fidelity. But there has been much argument as to what is a hi-fi frequency response.

First it should be pointed out that there are different ways of specifying frequency response. One amplifier may advertise that it has a frequency response from 30 cycles to 15,000 cycles. This is an inadequate specification. What we want to know is over what frequency range an amplifier responds uniformly, so as to give an output corresponding to the input at all intermediate frequencies? This is what we need to know to insure that none of the musical overtones is reproduced out of proportion.

But no amplifier is *absolutely* uniform in its amplification of all frequencies and consequently a good specification will state by how much the amplification deviates over a specified frequency range. Some will quote a deviation within 3 db, others 1 db, some .5 db, and yet others even closer fractions of a db. The trend toward less deviation in the frequency response has led many to believe that this is a complete measure of amplifier quality. An amplifier with a deviation of only .1 db between 30 cycles and 20,000 cycles should sound much better than one with a deviation of .5 db over the same frequency range surely?

The fact is that, if these figures tell the whole story, *one should not be able to tell the difference.* It takes quite careful listening to distinguish a level change of 3 db at the *same* frequency, so it will take extremely careful listening to tell a difference in level of 3 db *at a different frequency.* More important from the point of view of performance is how rapidly the amplification changes as the frequency is changed.

If the response curve is published, rather than a simple statement of deviation and frequency range (*e.g.,* within 2 db from 30 cycles to 20,000 cycles), much can be told from the *shape* of the curve. If it shows a "slow" 2 db rise, from 100 cycles to 10,000 cycles, you will probably never hear it. But if there is a change in level of 2 db between 5000 cycles and 10,000 cycles, this can make considerable difference in the sound of the amplifier.

The change in sound is not due to

the difference in amplification at 10,000 cycles and 5000 cycles, respectively, but because of the things that an amplifier with this kind of response will inevitably do to transients. An amplifier should not show any peak at any point in its response curve (that is, the response should go downwards at the ends rather than upwards), and it should not go downwards too abruptly.

A safe rule is that the first 1 db drop from level should take place in not less than an octave. The next 2 db (making 3 db drop in all) should take place in not less than another octave. This is illustrated in Figs. 1 and 2.

Even when you have checked the frequency response as published and, possibly, even had the actual amplifier frequency response measured, this is not necessarily a guarantee of acceptable performance. There are several reasons for this.

Frequency responses are usually measured with the amplifier feeding a resistance load, not a loudspeaker. The reason for this is that no two loudspeakers have the same impedance characteristic. They are not pure resistances and no two of them deviate in precisely the same way from the nominal resistance value. Consequently, specification of an amplifier's frequency response with one loudspeaker will not hold for another speaker. To standardize the frequency response of the amplifier it is more practical to use a resistance load.

However, this does not tell how much the frequency response is likely to differ when connected to a loudspeaker, rather than to a resistance load. This is what no amplifier specification tells, mainly because it is practically impossible to do so. How is one to standardize on the kind of deviation a loudspeaker impedance can provide for the amplifier? Nevertheless, one amplifier will produce very little difference in its response when feeding a loudspeaker while another may all but go into oscillation when a loudspeaker is connected.

So again the only way to really judge an amplifier is to listen to it. For this purpose the important thing is to listen to the amplifier with the loudspeaker with which it is to be used.

Distortion Measurements

Finally we come to the question of distortion figures. How much distortion is audible and what is the difference between harmonic distortion and IM distortion?

Tests made many years ago suggested that distortion less than 5% was inaudible. The method used was to produce deliberate distortion in the form of a second harmonic to the fundamental. This is equivalent to adding a first overtone musically, and a 5% component is 1/20th of the magnitude of the fundamental. Anything less than this is inaudible, these tests claimed.

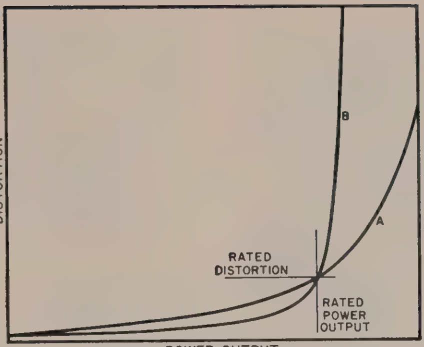


Fig. 3. Which power vs distortion curve indicates the better sounding amplifier? Both have the same rated power output and distortion rating, but (A) will probably give the better impression of distortion-free power when judged by listening test.

Possibly high-fidelity listeners are more discriminating now than then, but even so this particular form of distortion is by far the least noticeable. Most of the early amplifiers using simple triodes without any feedback produced mainly second harmonic distortion. They must have produced intermodulation distortion as well but it was not of a drastic order.

Later, to improve amplifier performance, push-pull circuits, pentodes, and feedback have been used. These measures result in distortion figures, either harmonic or IM, that are a fraction of 1%, yet the distortion *still* seems to be very audible under certain conditions. How come?

This is partly due to the measurement technique and partly due to the fact that different kinds of distortion become evident. A distortion of 1% means that the distortion component is 40 db lower in loudness than the original program component. If this is clipping, for example, it sounds very much as if the loudspeaker cone or voice coil were knocking against something. A little buzz, jingle, or knock that is 40 db lower in level than the desired program can be quite audible—even annoying. So 1% distortion that is all clipping is quite audible.

Some of the jingling and buzzing sounds may be forms of intermodulation. A fluttery sound can be produced by another kind of intermodulation distortion. It was because the straight harmonic distortion test did not give a good indication of the audible effect that different methods of intermodulation testing were introduced.

At one time it was thought that a simple ratio, such as 1 to 2.5 or 1 to 3.2, would specify the relationship between harmonic and intermodulation distortion. For example, if the harmonic distortion is 1%, then the intermodulation distortion might be expected to read 3.2%. But no such simple relationship exists. The relative results depend on many factors—some in the kind of distortion and some in the measurement method.

When it comes to the audibility of these results, this is an even more complicated story. Some kinds of distortion that an amplifier can produce will actually give lower readings on the IM test than on the harmonic test and yet be more audible in practical listening, although usually the IM reading is a higher figure than the harmonic.

An amplifier should not give distortion readings of more than 2 or 3 percent of any kind if it is to be regarded as a high-fidelity amplifier. But if its distortion readings are appreciably less than this figure the only way to judge what the amplifier really does is to listen to it. This is partly because different kinds of distortion can give dramatically different readings and partly because many amplifiers produce distortion *that the measurements don't show up at all.* See Fig. 3.

All distortion measurements are made with some kind of steady tone: either a 1000-cycle note being steadily played or a combination of tones, as used for the IM test. Neither of these are exactly musical in value. Musical programs consist of continuously varying tones and combinations of tones, which set a completely different requirement for the amplifier to meet. It must be capable of amplifying these continuously varying combinations of tones without their disturbing its balance in any way.

This is what many amplifiers that give wonderful distortion readings under test conditions fail to do when amplifying programs. Several organizations are taking steps to measure these effects more precisely and to establish measurement techniques that will give readings more truly indicative of performance.

Meanwhile, however, it is good to know just what to listen for in judging whether an amplifier produces such defects. We can list three particular things to listen for.

1. A kind of shock-excited intermodulation distortion that amplifiers produce. This is best heard with an instrument like a plucked guitar or something with extremely sharp spikey transients. It will show up most playing chords, such as a diminished seventh. Surprisingly few amplifiers clear this test with a good mark. When playing these particular chords, a sort of jangle of fairly low pitch is often noticed. If the chord is reproduced cleanly so that the individual strings stand out clear without any muddiness or jangling, then the amplifier does not produce this particular kind of shock-excited IM distortion.

2. Another kind of distortion is produced by a combination of very low notes with the middle register. This can usually be detected on recordings of organ music where there is plenty of the heavy pedal tones. In such instance the heavy bass notes cause the middle register program to go wavery. The rest of the music should sound just as steady when the heavy bass notes are played as when they are absent.

3. Another kind of distortion occurs when the program waveform is what technicians call "asymmetrical." This is usually produced by wind instruments. Due to the fact that the wind travels in one direction through the instrument, the waveforms it produces acoustically are also asymmetrical or

(*Continued on page* 121)

COVER STORY |

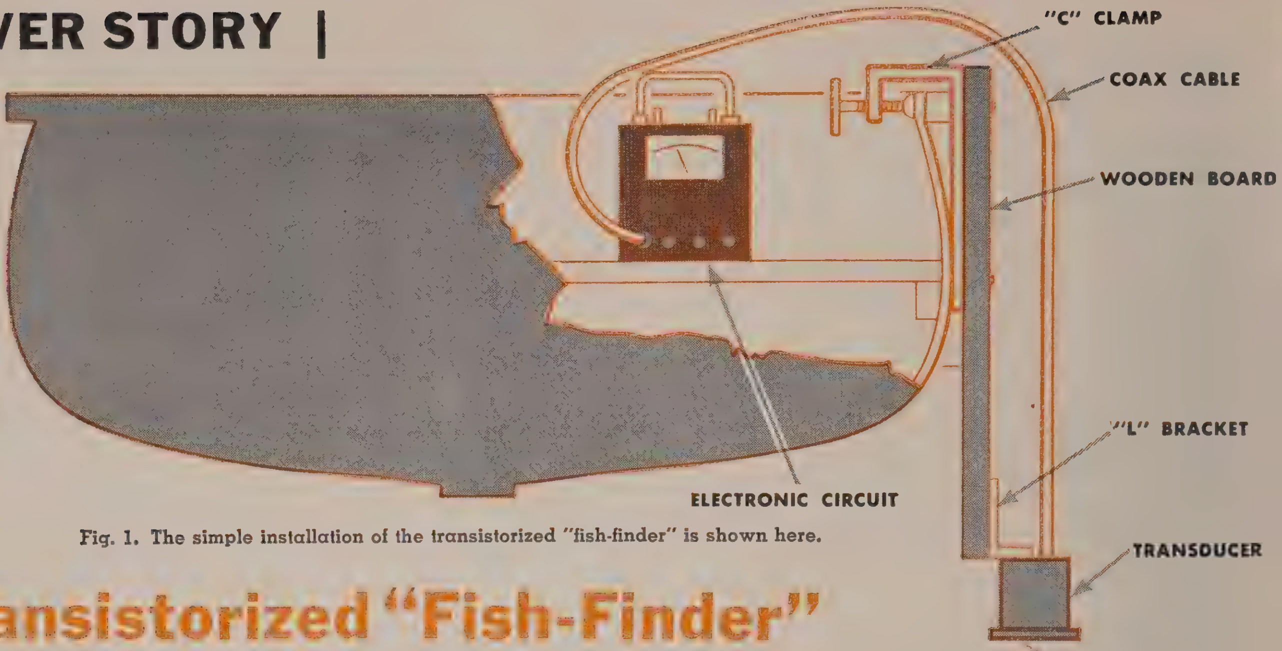


Fig. 1. The simple installation of the transistorized "fish-finder" is shown here.

Transistorized "Fish-Finder"

By **WALTER F. MITCHELL** / General Electric Co.

Construction of an all-electronic depth meter. This highly portable unit has a range of up to 100 feet.

EDITOR'S NOTE: *For those of our readers planning to build this unit, it should be pointed out that the total cost of the transistors and diodes may amount to about $55. To this must be added the price of the transducer ($25), the microammeter, and the other components. Using all new parts, the total cost of this unit will exceed $100.*

There are available a number of commercial depth finders, both the all-electronic and mechanical types. These are made by such companies as Bendix, Edo, Lowrance, Raytheon, Ross, *and* Sonar. *Units roughly comparable to the "fish-finder" described here, except with a rotating-light indicator, range in price from about $130 to $200.*

THIS unit should be a "must" to all fishermen like myself. I have spent a great sum of money on all kinds of fishing equipment and have had average success. With this unit a fisherman can locate bars, shoals, and places where fish are most likely to be. With a little practice the depth of one or more fish can easily be determined.

This electronic fish locator and depth meter is designed for use in a boat of the outboard motor class. It is an extremely small portable unit using 12 transistors and a small barium titanate transducer assembly. This assembly is easily clamped to the side of any boat with no alterations necessary to the boat. The range of this unit is three to one-hundred feet in depth.

From experiments conducted so far, one 45-volt "B" battery costing about $2.70 should last all season. No troubles have been encountered from boat turbulence or operation over a wide range of water and air temperature. The ignition noise from the outboard motor has not given any trouble on wood or Fiberglas boats.

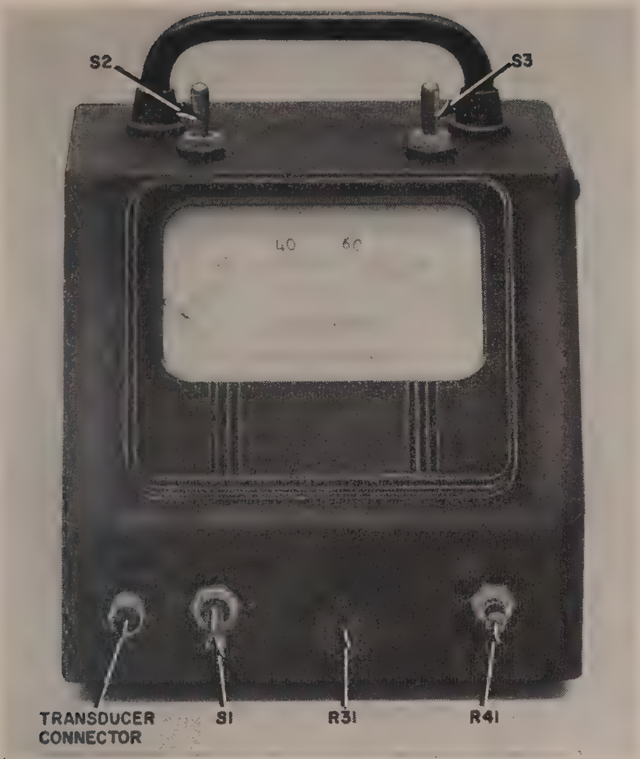
This electronic sonar unit is not entirely new. A much larger unit using tubes has been in production a long time, and some of the first of such units were used during the war by the Navy to locate submarines. Later, commercial fishermen used similar units to locate large schools of fish. This unit, due to its small size and low battery drain, can be of use in the rowboat class in both fresh and salt water.

The principle of sonar is similar to radar. A radar set sends out a series of pulses at ultra-high frequencies. Upon striking an object they are reflected back to the antenna. These weak pulses are amplified, then presented on a scope for viewing. The length of time it takes for one or more pulses to reach the target and return is calibrated in microseconds or miles (12.2 microseconds-per-mile both ways).

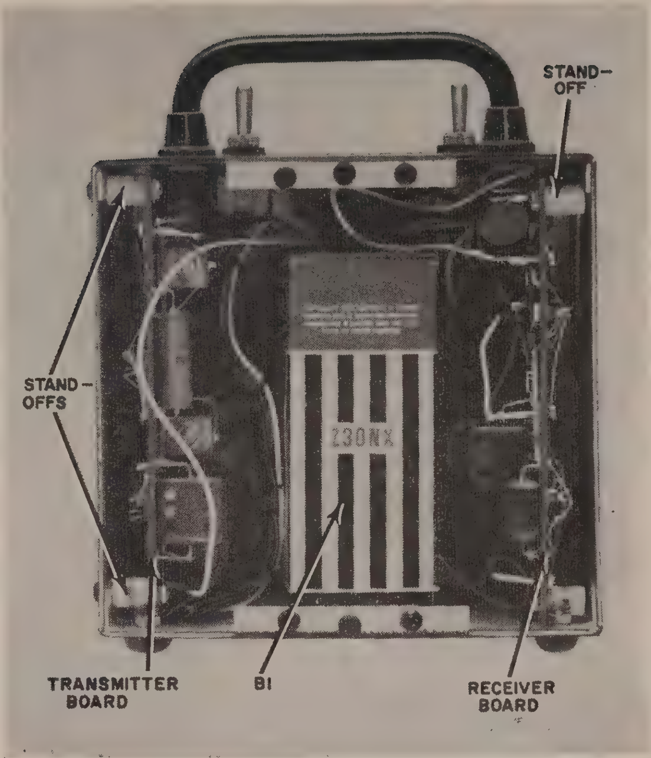
The speed of sound in water is 4800 feet-per-second. So if we send sonic pulses down into the water, upon striking an object at a depth of 100 feet, they will be reflected back to the source in 1/24th of a second.

An electrical pulse of high frequency every 1/24th second is applied to the transducer, converting it into a pulse of sound which travels through the water until it is reflected by the bottom or an object. An echo is received by the same transducer, changed into electrical energy and amplified. The time from the transmitted pulse to the echo is measured; this time is proportional to the depth which is indicated by a meter.

This fish locator consists of a transducer assembly approximately 3" in diameter and 2" high, a universal type



Front view of electronics unit of depth meter. Depths, in feet, are read directly on the microammeter's 0-100 μa. dial scale.



Rear view of the unit with its back panel removed. Both circuit boards, placed on edge, are mounted with stand-off posts.

mounting "L" bracket, and a 6" x 5¾" waterproof cabinet housing the indicator meter, battery, and electrical circuit. A 4-foot waterproof cable is connected to the transducer. Total weight is approximately 5 lbs. Fig. 1 illustrates the complete assembly and shows its installation.

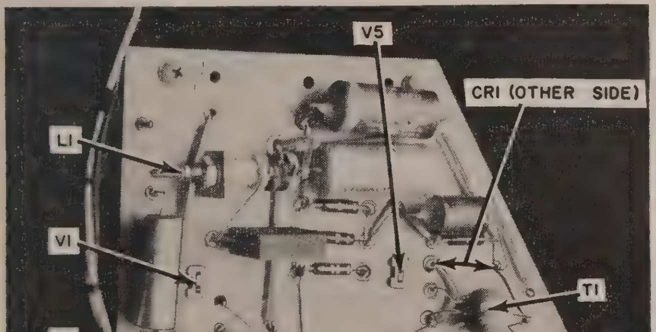
Transducer Assembly

The transducer employed was actually built by the author, but since special facilities are required, it is suggested that a ready-made unit be purchased. The transducer is made of 16 pieces of barium titanate 400 x 250 x 250 mils in size. (See Fig. 2.) All pieces were ground to the same 400-mil length. This length determines the frequency. After grinding and cleaning, both ends were silvered, then baked in an oven to 600°C. The elements were then put in silicon oil and heated up to the Curie point. At this time a high voltage of 20 volts per mil, or 8000 volts, was applied to the silvered ends. They were next brought down in temperature beyond the Curie point where they became polarized and exhibited piezoelectric properties. The polarization was found with a vacuum-tube voltmeter by connecting the meter across the silvered ends and pressing down with rubber erasers.

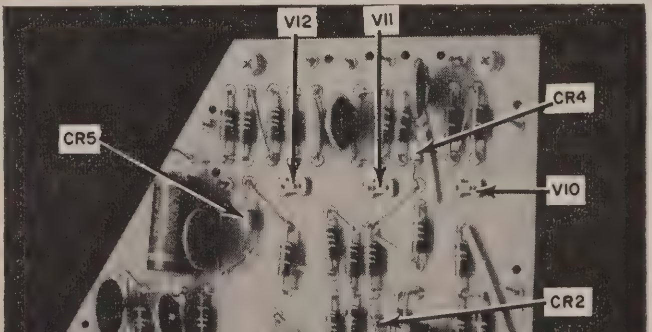
To assemble these pieces of titanate into an array, they were cemented to cork with rubber cement on all sides except the one which is to face the window. This window is a special rubber which has the same sonic properties as water. All 16 pieces of barium titanate were cemented in block form as shown. They were then ready to have silver tinsel wire soldered to both faces.

To assemble this block in a waterproof housing it was necessary for a platform to be built into the housing.

Components mounted on transmitter board are shown in this view.



View showing components that are mounted on the receiver board.



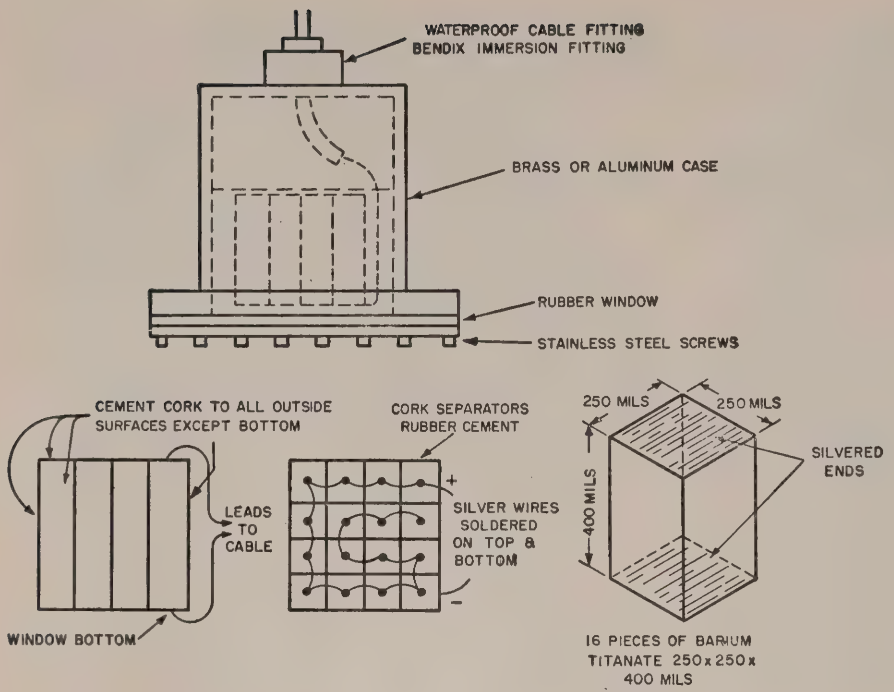

WATERPROOF CABLE FITTING
BENDIX IMMERSION FITTING
BRASS OR ALUMINUM CASE
RUBBER WINDOW
STAINLESS STEEL SCREWS
CEMENT CORK TO ALL OUTSIDE SURFACES EXCEPT BOTTOM
LEADS TO CABLE
WINDOW BOTTOM
CORK SEPARATORS RUBBER CEMENT
+
SILVER WIRES SOLDERED ON TOP & BOTTOM
-
250 MILS
250 MILS
400 MILS
SILVERED ENDS
16 PIECES OF BARIUM TITANATE 250x250x 400 MILS

Fig. 2. Mechanical details showing the construction and assembly of transducer.

A thin piece of cork was cemented to this platform, then the transducer was cemented to it. There should be approximately 1/16" clearance between the transducer and the rubber window.

The two silver leads were then connected to the cable, one to the center conductor and the other to the shield. Next the complete unit was evacuated at 15 pounds per-square-inch under castor oil. The vacuum was removed and the window was assembled without removing from the castor oil.

The unit was then ready for test. If assembled properly, no air will be trapped inside.

The slightest movement of the transducer is conducted to the oil, from the oil to the window, and from the window to the water. If air were present, it would be compressed and sound would not enter the water. This is also why we soap the window before immersion, to make sure there is intimate contact between the window and the water.

A complete transducer can be purchased from *Metron Mfg. Co.,* R. D.

(*Continued on page* 108)

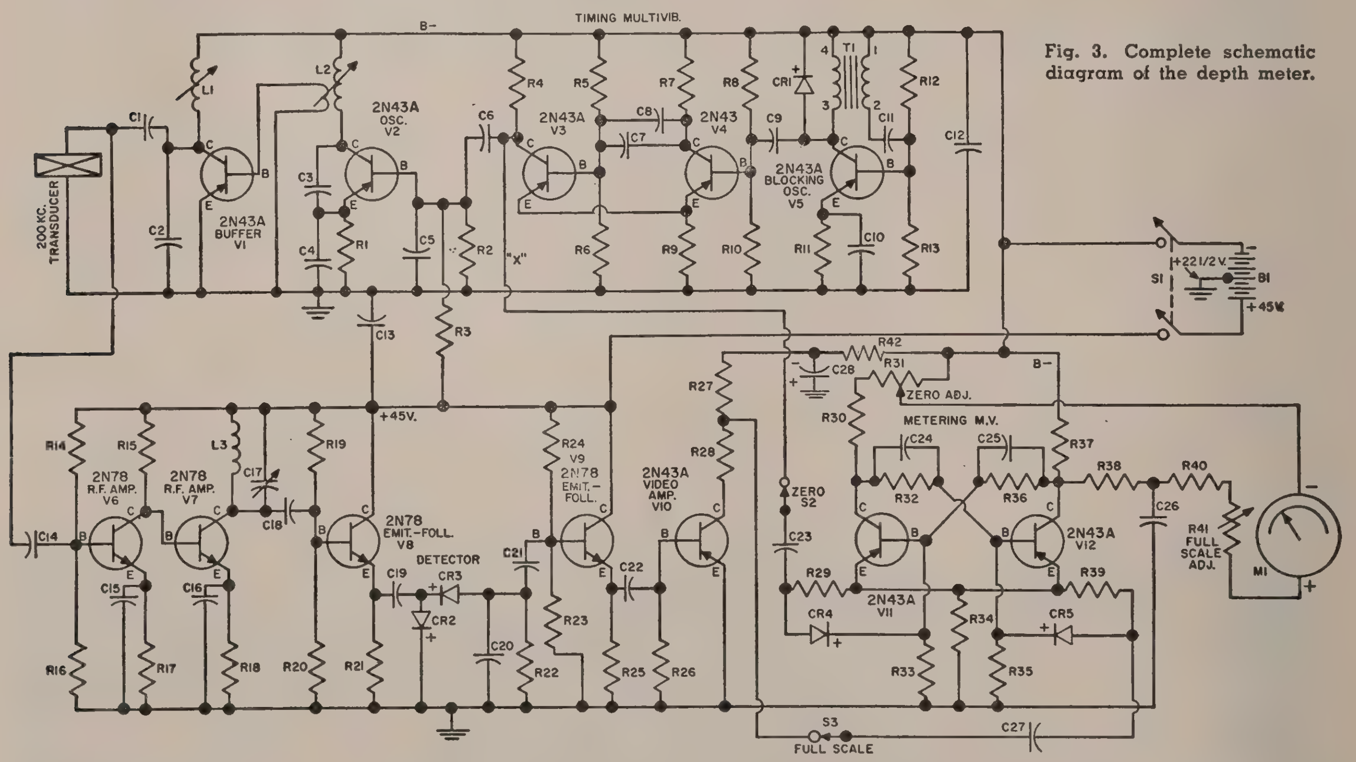
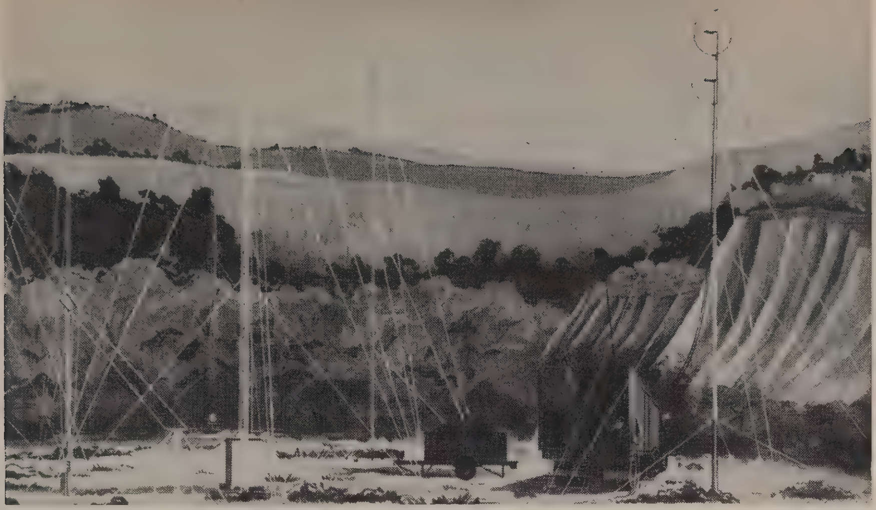

B-
TIMING MULTIVIB.
200 KC. TRANSDUCER
L1
L2
C1
C2
2N43A BUFFER V1
2N43A OSC. V2
C3
C4
R1
C5
R2
"X"
C6
2N43A V3
R4
R5
C7
C8
R6
R7
2N43 V4
R9
R8
R10
C9
CR1
T1
4
3
1
2
C11
2N43A BLOCKING OSC. V5
R11
C10
R12
R13
C12
S1
+22 1/2 V.
B1
+45V.
C13
R3
+45V.
R14
R15
2N78 R.F. AMP. V6
2N78 R.F. AMP. V7
L3
C17
C18
R19
C14
C15
C16
R16
R17
R18
R20
2N78 EMIT.-FOLL. V8
R21
DETECTOR
C19
CR3
CR2
C20
C21
R22
R24
V9 2N78 EMIT.-FOLL.
R23
C22
R25
R26
2N43A VIDEO AMP. V10
R27
R28
C28
R42
R31
ZERO ADJ.
R30
ZERO S2
C23
METERING M.V.
C24
C25
R32
R36
R37
R38
R40
C26
R41 FULL SCALE ADJ.
M1
2N43A V11
2N43A V12
R29
R39
CR4
CR5
R33
R34
R35
S3
FULL SCALE
C27
B-
C
B
E

Fig. 3. Complete schematic diagram of the depth meter.

R_1—5600 ohm, 1/2 w. res.
R_2, R_{10}, R_{32}, R_{36}—22,000 ohm, 1/2 w. res.
R_3, R_8, R_{19}, R_{20}, R_{22}, R_{23}, R_{24}, R_{40}—100,000 ohm, 1/2 w. res.
R_4, R_{37}, R_{42}—4700 ohm, 1/2 w. res.
R_5, R_{13}, R_{29}, R_{38}, R_{39}—47,000 ohm, 1/2 w. res.
R_6, R_7, R_{15}—33,000 ohm, 1/2 w. res.
R_9, R_{30}—3300 ohm, 1/2 w. res.
R_{11}—270,000 ohm, 1/2 w. res.
R_{12}—220,000 ohm, 1/2 w. res.
R_{14}—150,000 ohm, 1/2 w. res.
R_{16}, R_{18}, R_{21}, R_{25}, R_{26}—10,000 ohm, 1/2 w. res.
R_{17}—2200 ohm, 1/2 w. res.
R_{27}, R_{28}—1500 ohm, 1/2 w. res.
R_{31}—1500 ohm pot ("Zero Adjust")
R_{33}, R_{35}—6800 ohm, 1/2 w. res.
R_{34}—1000 ohm, 1/2 w. res.
R_{41}—50,000 ohm pot ("Full-Scale Adjust")
C_1, C_{21}—.1 µf., 200 v. paper capacitor
C_2—680 µµf. mica capacitor
C_3—1500 µµf. mica capacitor
C_4—4700 µµf. mica capacitor
C_5, C_9—.001 µf., 500 v. ceramic capacitor
C_6, C_{12}, C_{13}, C_{26}—1 µf., 200 v. paper capacitor
C_7, C_{15}, C_{23}, C_{27}—.005 µf., 500 v. ceramic capacitor
C_8—.02 µf., 200 v. paper capacitor
C_{10}—.22 µf., 200 v. paper capacitor
C_{11}—.05 µf., 500 v. ceramic capacitor
C_{14}—470 µµf. mica capacitor
C_{16}, C_{24}, C_{25}—.01 µf., 500 v. ceramic capacitor
C_{17}—7-45 µµf. ceramic trimmer
C_{18}—1000 µµf., 500 v. ceramic capacitor
C_{19}—470 µµf. mica capacitor
C_{20}—3300 µµf. mica capacitor
C_{22}—.25 µf., 200 v. paper capacitor
C_{28}—10 µf., 25 v. elect. capacitor
L_1, L_2—400-800 µhy., slug-tuned coil, ceramic form. L_2 has 7 t. sec. winding (available from Cambridge Thermionic Corp. #X-2060-10, Miller 4412 or equiv. can be used)
L_3—10 mhy. r.f. choke
T_1—331:1 blocking osc. trans. for 3 µsec. pulse (available Pulse Corp. Association of Los Angeles and Polyphase Institute Corp., Bridgeport, Pa. A UTC H-51 can also be used)
S_1—D.p.d.t. toggle switch
S_2, S_3—S.p.s.t. toggle switch, spring-loaded, normally closed
M_1—0-100 µa. meter
B_1—45 v. battery (Eveready W-350 or Burgess Z30NX)
CR_1—1N100 diode
CR_2, CR_3, CR_4, CR_5—1N98 diode
V_1, V_2, V_3, V_4, V_5, V_{10}, V_{11}, V_{12}—2N43A transistor
V_6, V_7, V_8, V_9—2N78 transistor
Transducer—See text
Note: All interconnections not on boards to be #20 shielded and insulated wire. Ground all shields and keep all leads away from receiver front end.



Artist's version of a field setup of the system. One of the two vans and power trailers is shown along with antennas for the u.h.f. relay link (right) and the rhombic transmitting and double-doublet receiving antennas (left). The rhombic's height has been exaggerated and its size reduced in this photo.

Transportable 10-kw. Radio Communications System

Complete military world-wide radio link can be air-lifted to any trouble spot on the globe by three transport planes.

A VERSATILE Army radio communications system has been developed which is geared to quick-reaction demands of small wars and brush-fire combat operations in trouble spots around the world. The new equipment can be transported by air or moved overland. It provides more voice and teletypewriter channels than ever before available in a high-speed mobile communications central. Designated the AN/TSC-16, it gives combat commanders a communications capability previously possible only in large, fixed radio installations.

The system provides the combat commander with two voice channels for separate conversations, and as many as 16 teletypwriter channels. A facsimile facility can be substituted for one of the voice command channels, and an additional radio voice channel is available for technical or operator's messages. By comparison, the best combat communications system available to U. S. Army forces during the recent Lebanon crisis provided no voice channels and only four teletypewriter channels.

As evidence of the importance and urgency of the program, proposals were to be submitted by manufacturers within two weeks of the original announcement, and a target delivery time of 120 days was set up. In addition, the contract, when awarded, would include a heavy liquidated damages clause for late delivery. The contract was awarded to *Adler Electronics, Inc.,* of New Rochelle, N. Y., which has already delivered four of the half-million-dollar systems.

With an operational range of 1000 to 2000 miles, the equipment links the field commander directly with the Army's global communication system. An AN/TSC-16 with a task force in Southeast Asia, for example, could join the world-wide network in Okinawa, Japan, the Philippines, or Hawaii. Through any of these points, the commander of such a task force could talk directly with members of the military staff in Washington. The additional channels provided by the equipment could simultaneously handle other operational messages.

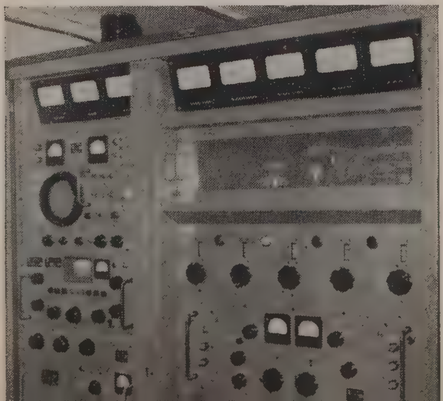
The system consists of two large trailer trucks and two power trailers. One of the vans contains a 10-kw. transmitter with facilities for simultaneous transmission on both the upper and lower sidebands. The other van contains the receiving, control, and terminal equipment. Communications between the two vans is by means of a u.h.f. radio relay link. Each van is equipped with air conditioning and heating, test equipment, and storage for over 15,000 spares. A dual, 30-kw. trailer-mounted Diesel generator set powers each van. One generator is sufficient to operate each van at full load, while the second generator on the trailer has been included solely as a standby unit.

The system—with 46 operating personnel—can assemble, load into three C-124 aircraft, and be airborne within 12 hours. On arrival, the communications central can be ready for interim operations in about four hours, but it requires two days to erect a more efficient rhombic transmitting antenna for full-capacity operation. —30—

One of the two 30-kw. trailer-mounted Diesel power generators. The tubular frame actually serves as a fuel tank—holding enough fuel for 24 hours of operation.

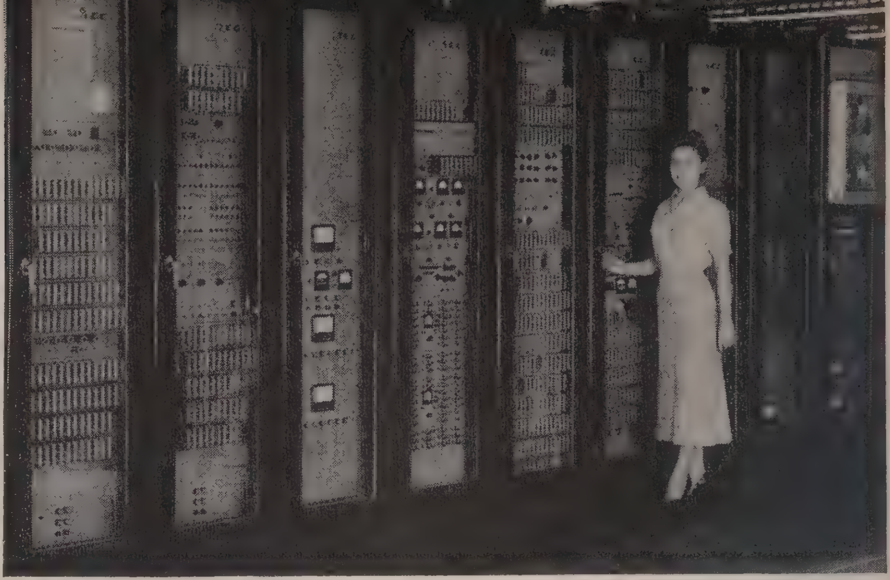
Interior view of the van containing all the receiving and the terminal equipment.

Front view of some of the transmitting equipment to be found in second van.



Computer-Language Translator

Delivery of the first flight test digital data processing system with a computer-language translator was announced by *Electronic Engineering Co.* of Calif. and the *Martin Co.* The translator makes it possible for missile flight test data to be converted into *IBM* 704 computer format, *via* magnetic tape recordings, without going through manual data reduction and card input to the computer.



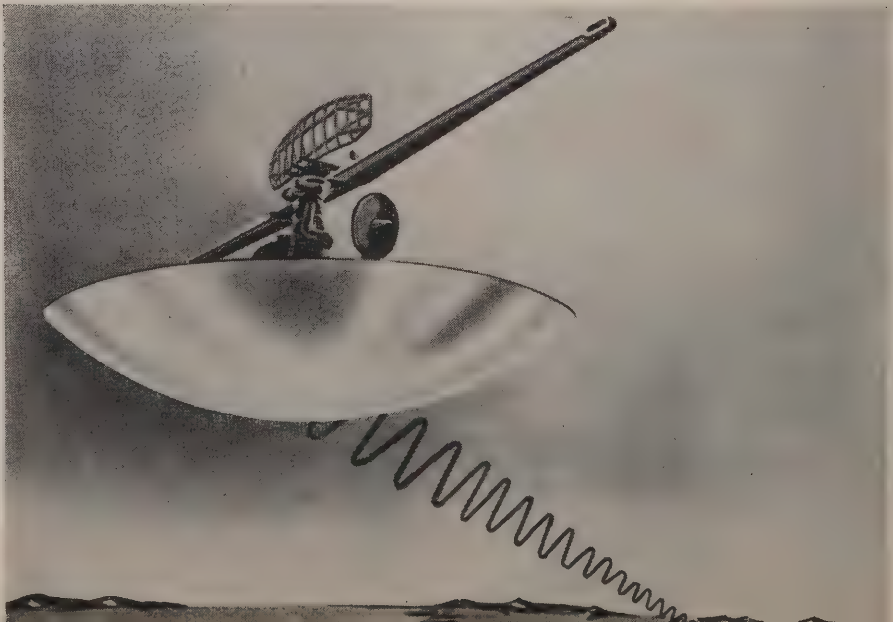
recent developments in electronics

TV Broadcast Antenna Shipped in One Piece

One of the longest television broadcast antennas ever shipped in one piece, this 78-foot, 4-bay batwing is loaded aboard an extra-long tractor trailer for shipment to KTVI in St. Louis. Made by *G-E,* the new antenna will replace one blown down during last February's tornado, which completely wrecked the tower as well. The antenna will be mounted atop a 978-foot tower. The trailer carrying the antenna traveled over a special route to avoid sharp curves and low bridges.

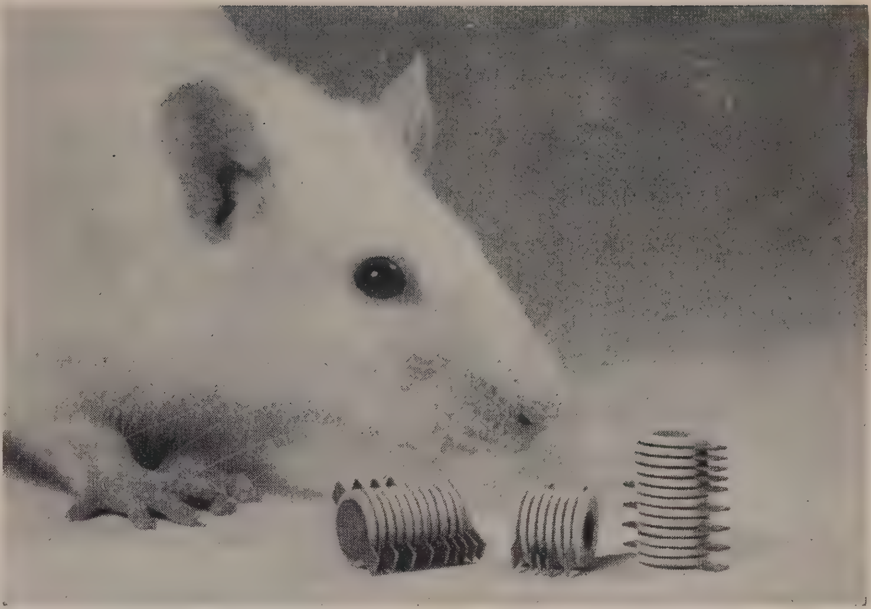
Electromagnetic "Extension Cord" for Space Stations

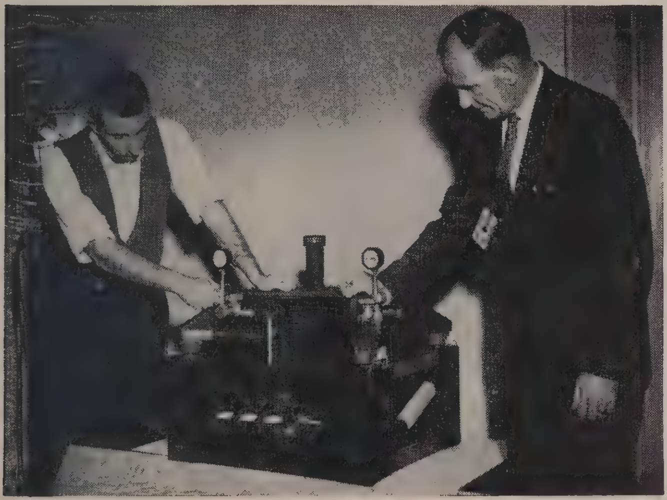
Plans for the development of saucer-like platforms which would be stationed miles above the earth for long periods of time were disclosed by the *Raytheon Co.* Supplying the power to keep the stations aloft will be a powerful beam of microwave energy from transmitters on earth. This energy would be converted into heat aboard the platforms.



Ceramic Stacked Module for Space Electronics

A small white rat, who is booked as a space passenger, inspects *General Electric's* new concept for space electronics. Each tiny ceramic module is a complete circuit, including several vacuum tubes and associated resistors and capacitors. Called TIMM's, for "thermionic integrated micro-modules," the tiny ceramic capsules generate their own high operating temperature, requiring only ¾ watt of power from an external source. Less than ⅓ inch in diameter, the TIMM's can be built into stacks several inches long depending on the complexity of the circuit.



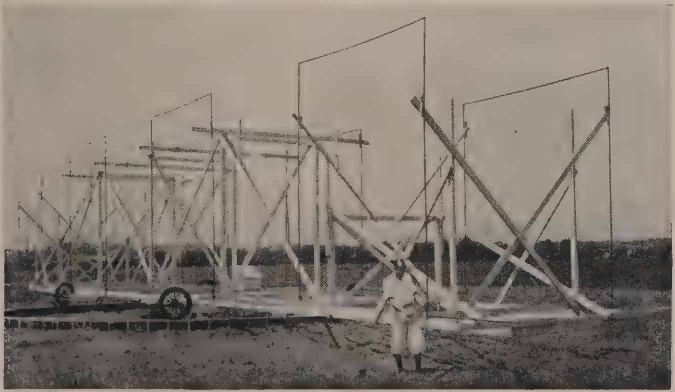


"Miniature" 5-kw. V.H.F. Amplifier

The *Martin Co.* has developed this 5-kw. output v.h.f. amplifier complete with power supply which has been delivered to the Air Force for testing. The unit weighs less than 200 pounds and occupies a space of less than 3 cu. ft. A new cooling, technique, evaporative cooling, is used in which internal heat is conducted directly into water, causing boiling. The boiling water then serves as coolant as a result of vaporization and the release of steam.

New Communications Research Center

A historic photo of the late Karl G. Jansky of *Bell Telephone Laboratories* with the rotating antenna which he used in the discovery of radio waves coming from the Milky Way, and whose studies resulted in the science of radio astronomy. The work was done at Holmdel, N. J., which will be the site of a new $20-million laboratory to be built by *Bell.*



New Way to Grow Germanium

Westinghouse has developed a revolutionary method of growing germanium crystals as thin, uniform, flat ribbons instead of round ingots. Thus the semiconductor grows directly in the exact form in which it is used in transistors and similar devices.

By **HARTLAND B. SMITH**

Compact fixed or mobile rig makes possible two-way contacts when used with 11-meter receiver without requiring amateur or commercial operators' license.

Versatile Citizens Radio Transmitter

"WOW! What a traffic jam! Better not start supper yet, honey. I'm gonna be plenty late tonight."

"OK dear, I'll wait until I hear from you again."

"Fine! I'll give you another call as soon as I get out of this miserable tie-up. 19W1375, unit 1 clear."

"I'll be listening. 19W1375, unit 2 clear."

This sort of conversation is going to become more and more commonplace on the airwaves now that the FCC has revised its rules for the Citizens Radio Service. Although Citizens Radio has been in existence for a decade, its growth, up to this time, has been hampered by equipment specifications so stringent that they could only be met with commercially manufactured gear. Furthermore, the original 460 mc. assignment just about limited communication to line-of-sight when employing low-power transmitters. In open country, results were often quite good, but even a half-mile range was sometimes difficult to achieve in built-up urban areas. In order to make contact over greater distances, high antennas and powerful transmitters were required. The cost of such equipment was so great that the average private citizen, for whom the service was originally intended, just couldn't afford it.

Now, however, the picture has changed. An additional band, 26.96 mc. to 27.26 mc., has been assigned for use by Citizens Radio stations. Equipment specifications have been eased so that home-constructed, crystal-controlled transmitters may be used without having them tested by the Commission for approval. Best of all, on this new band, even simple equipment will provide reliable contact between a mobile and a fixed station over an area of from 100 to 300 square miles.

Any United States citizen, at least 18 years of age, may apply for a Citizens Radio License. No technical examination or operator's permit is required. The licensee may authorize any member of his family, a friend, or an employee to use his Citizens equipment either for business or for pleasure.

Class D Citizens Service

Radiotelephone transmitters operating in the newly assigned band are referred to as class D mobile stations. Even though one of these transmitters is connected to a permanent antenna at your home or office, in the eyes of the FCC, it is still regarded as a mobile unit. Class D stations are limited to a power input of 5 watts and may be operated on any of the 23 channels listed in Table 1. Although any person may construct a crystal-controlled Citizens transmitter and adjust it when connected to a dummy load, the completed unit must be installed and maintained under the supervision of a 1st or 2nd Class Commercial Radio Operator. Except in an emergency, contacts with stations operating in other services (Amateur, Aviation, Public Safety, etc.) are not permitted.

Although class D transceivers are already beginning to appear on the market, many technicians and hobbyists will prefer to construct their own Citizens Radio equipment. Many readers of this magazine own sensitive receivers which are capable of tuning the 27 mc. band. Those who don't already own such units can purchase, at relatively low cost, short-wave converters that will provide excellent 27 mc. performance when connected ahead of the average home or auto broadcast receiver. Especially recommended for the purpose are the *Gonset* Models 10-11, "Tri-Band," 3-30, "Super 6," and "Super 12," which are available either new or used from a number of the larger radio equipment distributors. In most cases, power to operate one of these converters can be robbed from the broadcast set to which it is connected. The "Super 12" requires no high-voltage "B plus" and is therefore especially suitable for use with 12-volt transistorized auto radios.

When an excellent receiver is either on hand or readily obtainable, the home constructor needs only to build a simple transmitter, similar to that shown in Fig. 1, in order to get going on the Citizens Band. Special provisions have been incorporated in this particular unit so that it can be used either at a fixed location or in an auto, truck, boat, or other vehicle. The power plug, on the rear panel, is wired for 6- or 12-volt a.c. or d.c. operation of the tube heaters. Between 200 and 250 volts, d.c., at approximately 60 ma. is required for the "B plus." At a fixed location, power may be obtained from a small a.c. power supply, like the one diagrammed in Fig. 5, or from the companion receiver. During mobile operation, power may be taken from the car receiver or from a small vibrator pack, many of which are commercially available, or from an inexpensive surplus dynamotor.

26.965	27.055	27.155
26.975	27.065	27.165
26.985	27.075	27.175
27.005	27.085	27.185
27.015	27.105	27.205
27.025	27.115	27.215
27.035	27.125	27.225
	27.135	27.255

The actual transmitter frequency must not deviate more than .005% (approximately 1.3 kc.) from the channel being used. Note that there are gaps in the above frequencies. The missing frequencies are not available for radiotelephony.

Table 1. Frequencies assigned in megacycles.

Transmitter Construction

The transmitter can be constructed in a *Bud* type C-1797 5" x 6" x 4" utility cabinet which comes with a built-in chassis. A 2" x 5" piece of aluminum, with a small lip bent at a right angle along its bottom edge, should be fastened at the rear of the chassis to provide a place for mounting the power and antenna connectors. Rubber grommets, pushed into holes drilled at the corners of the bottom of the case, act as protective feet for the instrument. Access holes which will allow screwdriver adjustment of the four tuning capacitors must also be drilled in the bottom of the case. Since the exact locations of these holes cannot be determined accurately until all components are permanently in place, don't attempt to drill them until the transmitter has been completely wired.

The parts layout shown in the photos, Figs. 2 and 3, should be closely followed. Four-inch leads must be soldered to each of the 8 active terminals of RL_1 before it is mounted, since these cannot be easily reached after the relay is once in place. The relay is the only component which must be prewired in this manner. All other parts can be easily reached with the tip of an ordinary soldering gun after they have been mounted.

The triode section of the 6AU8 (Fig. 4) acts as an overtone oscillator. When ordering a crystal for the transmitter, request a third overtone unit ground to any one of the channels listed in Table 1. Be sure to specify a frequency tolerance of .005% and inform the manufacturer that the crystal will be connected from grid to ground in an overtone oscillator circuit which utilizes the triode section of a 6AU8. This latter point is very important, because the exact operating frequency will be dependent upon the external capacity which appears across the terminals of the crystal. Overtone crystals are usually furnished with pin diameters of either .050″ or .094″. Make certain that the crystal socket you purchase matches the pin size of your particular crystal. Some firms supply matching sockets with their crystals.

The pentode half of the 6AU8 is the r.f. power amplifier. By judicious use of parasitic suppressors and grid loading, pentodes are often operated without neutralization. However, such measures tend to use up driving power and to reduce amplifier efficiency. In this transmitter, rather than waste power with such brute force measures, V_{1B} is neutralized by means of C_4. Once this capacitor has been properly adjusted, the amplifier operates without the least sign of instability, even when working without a load.

Fig. 1. Compact 27-mc. radiotelephone transmitter will take up little space in the home or office and is small enough to be clamped to car's steering post or under dash.

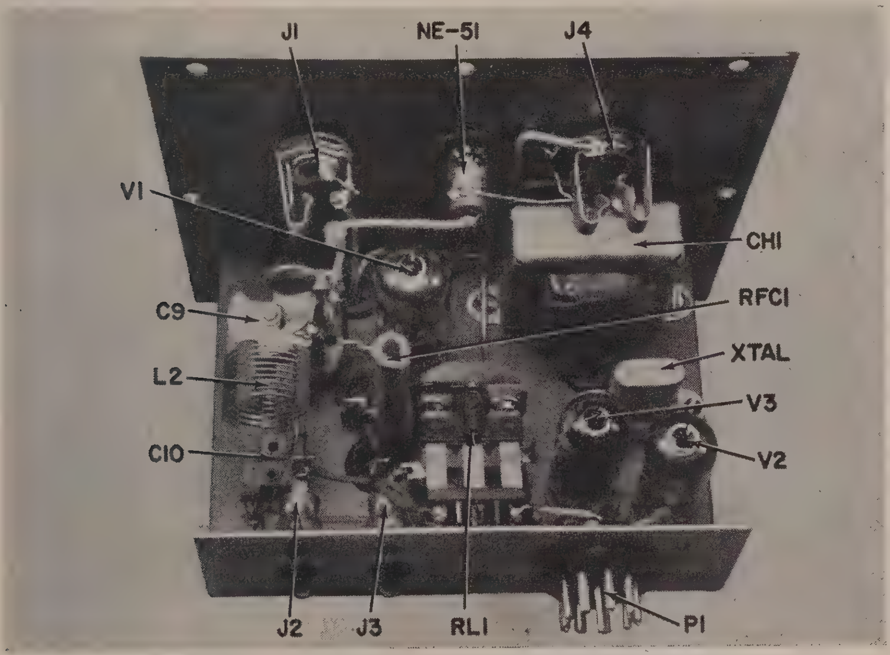
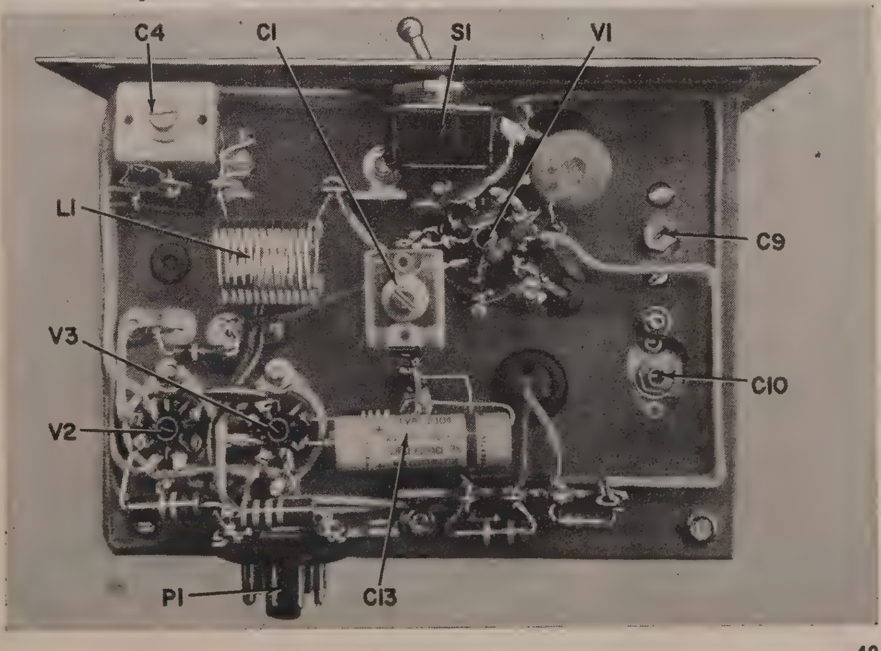


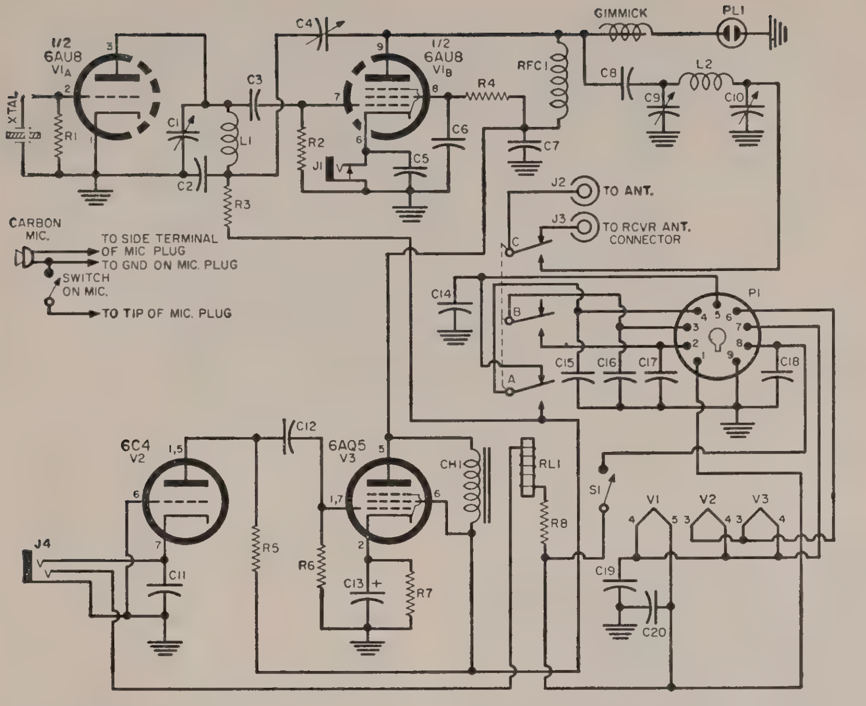
Fig. 2. Top-chassis view showing location of parts. Note that author wired up the transmitter directly from his schematic. No pictorial drawings are available.

The correct location of C_4 can be seen in Fig. 3. Mount this trimmer so that the movable plate, the one directly under the adjusting screw, goes to the point where L_1 and C_2 join. The lead running from the top of RFC_1 to the fixed plate of C_4 must be kept well away from the oscillator and amplifier grid circuits. A grommet-protected hole in the chassis should be placed close to the fixed plate of C_4. The least possible amount of wire should extend down from the top of the chassis, through this hole, to make connection with C_4. Above the chassis, this wire should run between CH_1 and the front panel on its way to the top, or plate end, of RFC_1.

To insure a minimum of extraneous coupling between the input and output circuits of the r.f. amplifier, the wire connected to pin 9, the plate of V_{1B}, should go immediately through a hole in the chassis to the top of RFC_1. That portion of the plate lead which extends beneath the chassis should be no more than ¾″ long.

Fig. 3. Under-chassis view of the Citizens Band transmitter unit.





R_1—100,000 ohm, ½ w. res.
R_2—10,000 ohm, ½ w. res.
R_3—33,000 ohm, 1 w. res.
R_4—15,000 ohm, ½ w. res.
R_5—15,000 ohm, 1 w. res.
R_6—330,000 ohm, ½ w. res.
R_7—390 ohm, 1 w. res.
R_8—10 ohm, 2 w. res.
C_1—2-30 μμfd. mica trimmer
C_2—620 μμfd. silver mica capacitor
C_3—10 μμfd. ceramic capacitor
C_4—1.5-15 μμfd. mica trimmer
C_5—.01 μfd. disc ceramic capacitor
C_6, C_7, C_{11}, C_{14}, C_{15}, C_{16}, C_{17}, C_{18}, C_{19}, C_{20}—.001 μfd. disc ceramic capacitor
C_8—.001 μfd., 1000 v. disc ceramic capacitor
C_9—50 μμfd. air padder
C_{10}—45-380 μμfd. mica trimmer
C_{12}—.0047 μfd. disc ceramic capacitor
C_{13}—10 μfd., 50 v. elec. capacitor
RFC_1—21 μhy. r.f. choke (Ohmite Z-28)
Xtal.—Third overtone crystal, .005% tolerance (see text)
S_1—S.p.s.t. toggle switch
L_1—12 t. #20 wire, ⅝" dia., ¾" long (B&W "Miniductor" 3007)
L_2—9 t. #20 wire, ¾" diam., ½" long (B&W "Miniductor" 3011)
CH_1—5.5 hy., 50 ma. filter choke (Knight 62G135 or equiv.)
RL_1—3-pole, d.t., 6-volt a.c. relay (Potter & Brumfield KA14AY)
J_1—Two-wire, closed-circuit jack
J_2, J_3—Chassis-type female auto antenna connector
J_4—Three-wire jack
P_1—9-prong male plug (Amphenol 86-CP9)
Gimmick—See text
PL_1—Neon monitor bulb (NE-51)
V_1—6AU8 tube
V_2—6C4 tube
V_3—6AQ5 tube

Fig. 4. Complete schematic and parts listing for the Citizens Band transmitter.

A rubber grommet, placed in a ½" hole in the center of the front panel provides a simple mount for the NE-51 neon monitor bulb, PL_1. The glass portion of the NE-51 is pushed part way through the grommet from the rear of the panel. Thus the bulb is held in place by friction and no socket is required. The ground lead to the NE-51 is soldered directly to the metal base of the bulb, while the lead from the "gimmick" is soldered to the tip. The gimmick is actually a very low value capacitor formed by twisting together two pieces of insulated hookup wire. When the transmitter is working properly, a small amount of r.f. flows through the gimmick to ignite the NE-51 which then gives off a purplish glow. Talking into the mike will cause the bulb to flash more brightly. Thus, the NE-51 acts as a monitor to inform the operator that all is well. Whenever it doesn't glow, or if it fails to flash as you speak into the mike, you instantly know that something is amiss and that it is time to take proper steps to remedy the difficulty.

The transmitter is designed to work in conjunction with a push-to-talk carbon microphone. Suitable examples include the Army T-26 chest mike, the *Bell* CM-1SC hand-held mike, and a telephone-style handset with switch. Do not attempt to use an Army type T-17 mike. Its output will be insufficient to adequately modulate the transmitter.

V_2 acts as a grounded-grid amplifier. It not only provides current to excite the carbon microphone, but also delivers an amplified signal to the grid of V_3, the 6AQ5 modulator tube. Heising, or choke-coupled, modulation is employed because it is low in cost, provides plenty of talk power, and yet is incapable of overmodulating the final. This latter feature is important because the Citizens Radio Regulations specify that, "modulation shall not exceed 100% on either positive or negative peaks."

A high degree of control-circuit versatility is provided by RL_1, a three-pole, double-throw 6-volt a.c. relay which is activated by the push-to-talk mike switch. The "C" portion of the relay changes the antenna back and forth from the receiver to the transmitter. The "A" section switches the high voltage, while the "B" section is connected to the power plug, P_1, where it is available to control an external circuit. For example, it can be used to short the speaker leads to mute the receiver while transmitting or to actuate the control relay of a vibrator or small dynamotor for battery operation.

As a result of its 6-volt rating, the relay coil will draw excessive current and become very warm if operated directly from 12 volts. Therefore, R_8 is employed to drop the current to a safe value during 12-volt operation. Since the addition of this resistor reduces the relay's sensitivity on 6 volts, a pair of long-nosed pliers should be used to slightly reduce the spring tension by carefully bending up the ear to which the spring is attached on the frame of the relay. Reduce the tension only enough to allow the relay to close dependably during 6-volt operation. If you bend the ear up too far, the tension will be so low that the contacts will not hold satisfactorily in the de-energized condition. Although designed for a.c., the relay works adequately on d.c. as well.

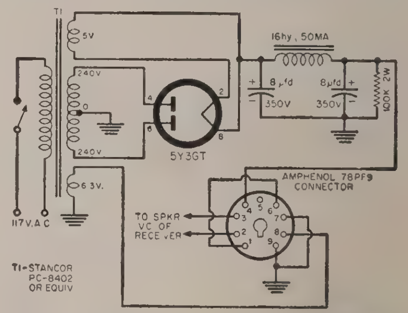


Fig. 5. Small power supply suitable for use with transmitter at fixed location.

All spurious emissions and harmonics must be at least 50 db below the unmodulated carrier of a Citizens Radio transmitter. In order to meet this specification, a number of precautions should be taken during the construction of this particular unit. For example, eight sheet metal screws, instead of the four furnished, should be used to fasten both the front and rear panels to the case. This will insure good electrical contact and maximum r.f. shielding. C_{11}, C_{14}, C_{15}, C_{16}, C_{17}, and C_{18}, with leads cut short, should be soldered directly to the terminals of J_4 and P_1. The purpose of these capacitors is to bypass any r.f. which might otherwise escape from the case *via* the power and microphone leads. C_5, on the other hand, instead of being mounted on J_1 should be placed right at the socket of V_{1B} where it can provide the shortest possible r.f. path between cathode and ground. The pi-network of the final amplifier circuit helps to reduce harmonics before they can reach the antenna and be radiated. On-the-air tests of the transmitter reveal that its harmonic output is truly insignificant.

Preliminary Adjustments

After the unit has been completed

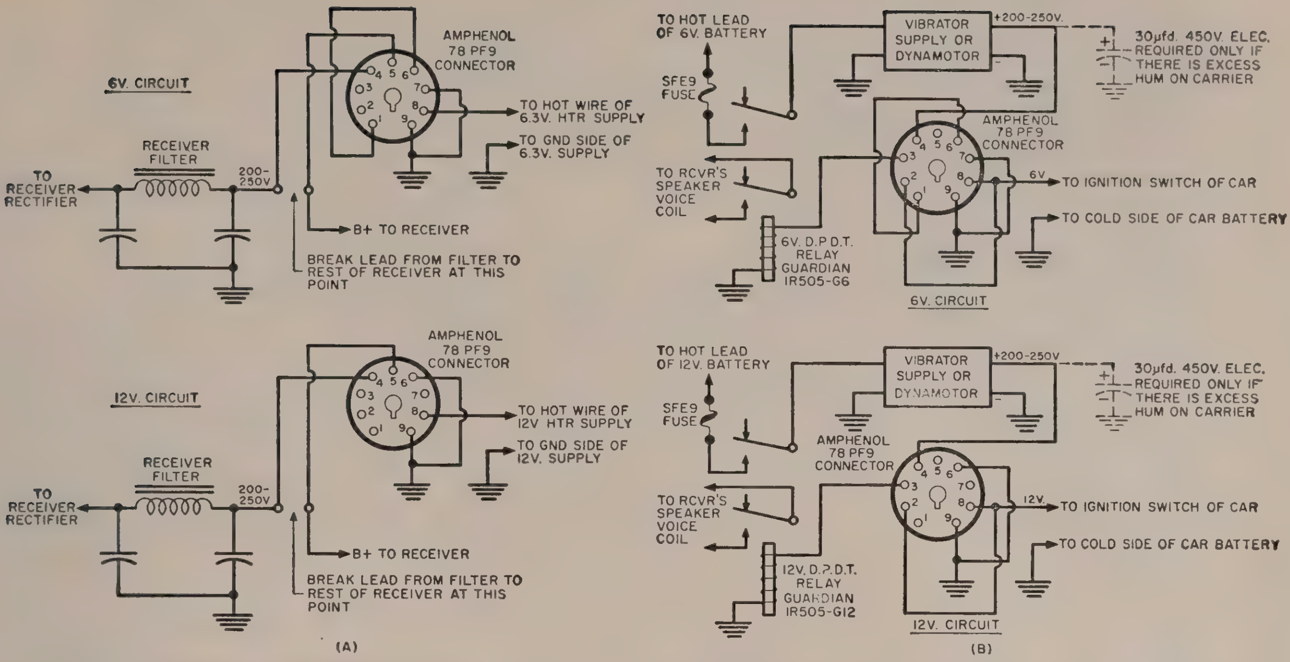

6V. CIRCUIT
AMPHENOL 78 PF9 CONNECTOR
TO HOT WIRE OF 6.3V. HTR SUPPLY
TO GND SIDE OF 6.3V. SUPPLY
RECEIVER FILTER
TO RECEIVER RECTIFIER
200-250V
B+ TO RECEIVER
BREAK LEAD FROM FILTER TO REST OF RECEIVER AT THIS POINT
TO HOT LEAD OF 6V. BATTERY
SFE9 FUSE
VIBRATOR SUPPLY OR DYNAMOTOR
+200-250V.
30μfd. 450V. ELEC. REQUIRED ONLY IF THERE IS EXCESS HUM ON CARRIER
AMPHENOL 78 PF9 CONNECTOR
6V
TO IGNITION SWITCH OF CAR
TO COLD SIDE OF CAR BATTERY
TO RCVR'S SPEAKER VOICE COIL
6V. D.P.D.T. RELAY GUARDIAN IR505-G6
6V. CIRCUIT
12V. CIRCUIT
AMPHENOL 78 PF9 CONNECTOR
TO HOT WIRE OF 12V HTR SUPPLY
TO GND SIDE OF 12V. SUPPLY
RECEIVER FILTER
TO RECEIVER RECTIFIER
200-250V
B+ TO RECEIVER
BREAK LEAD FROM FILTER TO REST OF RECEIVER AT THIS POINT
TO HOT LEAD OF 12V. BATTERY
SFE9 FUSE
VIBRATOR SUPPLY OR DYNAMOTOR
+200-250V
30μfd. 450V. ELEC. REQUIRED ONLY IF THERE IS EXCESS HUM ON CARRIER
AMPHENOL 78 PF9 CONNECTOR
12V.
TO IGNITION SWITCH OF CAR
TO COLD SIDE OF CAR BATTERY
TO RCVR'S SPEAKER VOICE COIL
12V. D.P.D.T. RELAY GUARDIAN IR505-G12
12V. CIRCUIT
(A)
(B)

Fig. 6. (A) Methods for obtaining transmitter power from fixed or mobile receivers or (B) from a 6- or 12-volt auto battery.

and a careful check for wiring errors has been made, preliminary adjustment of the transmitter can be accomplished in the following manner. Plug a microphone into J_4 and a 0-100 ma. d.c. meter into J_1. By means of an *Amphenol* 78PF9 connector, apply 250 volts d.c. to P_1, the positive terminal of which is pin 4 and the negative, pin 9. The heater voltage, either 6 or 12, goes to pin 8 and pin 9 of P_1. If 6 volts is applied, wire a jumper from pin 1 to pin 6 and another from pin 7 to pin 9 of the 78PF9 connector. If 12 volts is to be employed, only one jumper is required. It goes from pin 6 to pin 9. These jumpers are clearly shown in the schematics of Fig. 6.

Do not attach an antenna to J_2. Set C_4 at minimum capacity. Tighten the adjustment screw of C_{10} so that this trimmer is at maximum capacity. Close S_1. After allowing time for the tubes to heat up, push the "transmit" switch on the microphone. RL_1 should close.

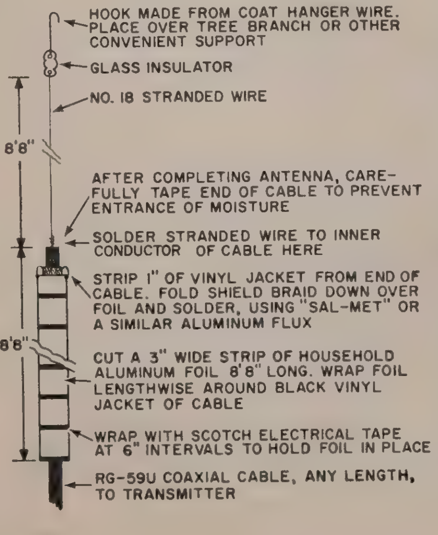
Tune across the 27 mc. band on your receiver to see if you can hear the signal from the transmitter. If no signal is present, reduce the capacity of C_1. At some spot in this trimmer's range of adjustment, the crystal stage will begin to oscillate and will produce a strong signal in the receiver.

Tune C_9 through its full range while watching the test meter. At least one dip in current should be noted. If there are two dips, the final amplifier is not completely neutralized. Tighten C_4 a little and then tune C_9 through its range again. One of the dips in current should become less pronounced. Keep tightening C_4 and operating C_9 back and forth until the weaker dip completely disappears. When the transmitter has been properly neutralized, the test meter will show only one dip in current as C_9 is tuned from minimum to maximum capacity. Since the adjustment screw of C_4 is connected to the "B" supply, use a well insulated screwdriver during the neutralizing process to avoid the danger of electric shock.

A dummy antenna, consisting of two No. 46 pilot bulbs wired in series, may now be connected between the center terminal of J_2 and the chassis. Tune C_9 to resonance as evidenced by the current dip on the test meter. Make a slight reduction in the capacity of C_{10} and then retune C_9 for minimum test meter current. Continue this process until the pilot bulbs are glowing at their brightest and the meter dip at resonance is very slight. Set C_1 at a point where the bulbs glow brightly and the oscillator starts reliably each time the mike switch is depressed. Now talk or whistle into the microphone. The pilot bulbs of the dummy antenna should grow brighter as you do this.

Since the power to light the NE-51 monitor is taken from that which would normally go to the antenna as a part of the radiated signal, it is important to keep the dissipation in the NE-51 as low as possible. Untwist the wires of the gimmick until the neon bulb barely fires when the mike button is depressed. One or two twists will probably provide sufficient capacity in the gimmick to make the NE-51 operate satisfactorily.

Fig. 7. Temporary vertical coax antenna.


HOOK MADE FROM COAT HANGER WIRE. PLACE OVER TREE BRANCH OR OTHER CONVENIENT SUPPORT
GLASS INSULATOR
NO. 18 STRANDED WIRE
8'8"
AFTER COMPLETING ANTENNA, CAREFULLY TAPE END OF CABLE TO PREVENT ENTRANCE OF MOISTURE
SOLDER STRANDED WIRE TO INNER CONDUCTOR OF CABLE HERE
STRIP 1" OF VINYL JACKET FROM END OF CABLE. FOLD SHIELD BRAID DOWN OVER FOIL AND SOLDER, USING "SAL-MET" OR A SIMILAR ALUMINUM FLUX
8'8"
CUT A 3" WIDE STRIP OF HOUSEHOLD ALUMINUM FOIL 8'8" LONG. WRAP FOIL LENGTHWISE AROUND BLACK VINYL JACKET OF CABLE
WRAP WITH SCOTCH ELECTRICAL TAPE AT 6" INTERVALS TO HOLD FOIL IN PLACE
RG-59U COAXIAL CABLE, ANY LENGTH, TO TRANSMITTER

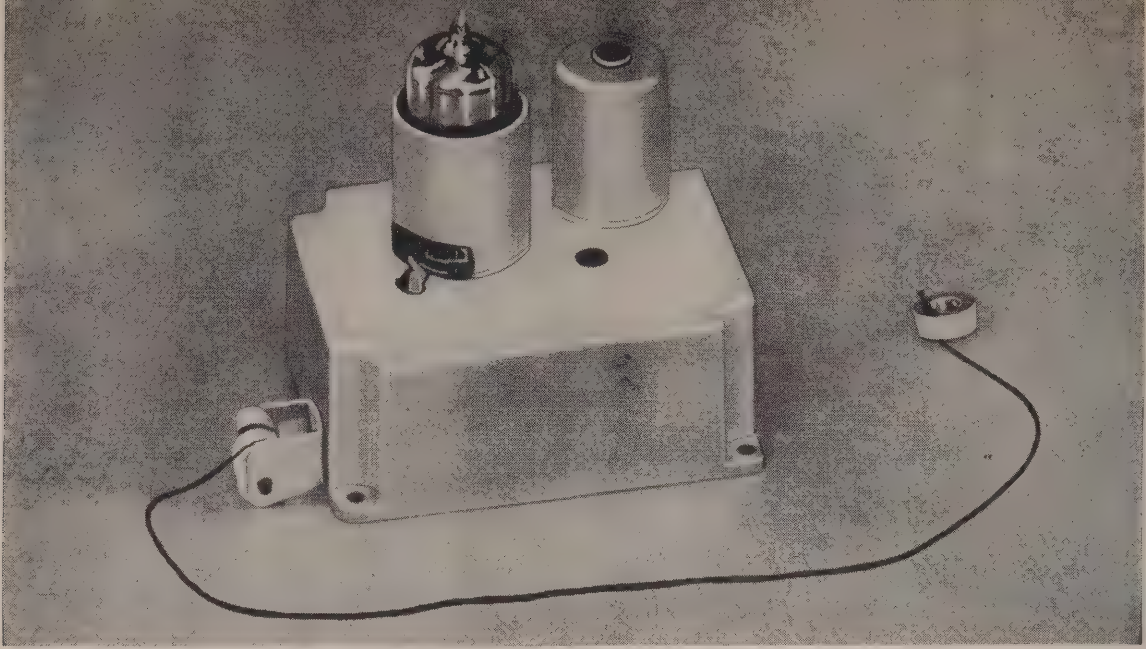
Although the previous tests can be made by anyone familiar with electronic circuits, all adjustments occurring after an antenna has been connected to the transmitter must be carried out by or under the supervision of a commercially licensed operator. Don't attempt to do this work yourself unless you hold such a license.

Antennas

In view of the 5-watt maximum rating allowed class D stations, an efficient antenna must be used if truly worthwhile results are to be achieved. When operating from a permanent location, a ground-plane antenna such as *Antenna Specialists* M-12, *Premax* GP-430, *Gonset* 3296, or *Heath* CBF-1 will not only provide exceptionally good coverage in all directions, but will concentrate the radiated energy along the horizon instead of letting it shoot off uselessly toward the sky. An inexpensive, but surprisingly effective temporary antenna, the coaxial vertical of Fig. 7, can be put together in a few minutes and hung from the branch of a nearby tree or suspended from the end of one of the elements on your TV receiving antenna. Note that the antenna at a fixed location may not be more than 20 feet higher than the building upon which it is mounted.

For mobile work, a 96" bumper-mounted whip with a spring base is recommended. Although an ordinary car receiving antenna can be used in a pinch, if it is extended to its full length,

(*Continued on page* 123)



This subchassis, integrating an r.f. and converter circuit, is made by General Instrument Corp. and used by manufacturers of FM tuners and receivers. Other units using this general type of circuit are imported from West Germany.

Don't Dodge the One-Tube FM Front End

By **GEORGE D. PHILPOTT**

This streamlined design, being adopted rapidly and widely, must be understood by the technician.

CONSIDERING the remarkable rate at which use of the single-tube, twin-triode r.f.-converter front end in FM designs is growing, *you may no longer be able* to avoid it by the time this copy of the magazine is in your hands. If you service, lack of understanding about this entirely respectable but somewhat off-beat circuit may cause some real headaches.

Despite several variations already extant, the basic circuit is popping up on all sides. The one singled out for discussion here (Fig. 1), featured in many *Telefunken* receivers imported from West Germany now in widespread use on these shores, is among the earliest to make an appearance. *Grundig* and other equipment widely sold in this country feature various versions. Many separate r.f.-converter subchassis from various sources that use the same circuit principles are being steadily imported by domestic manufacturers for incorporation in their FM tuners and receivers. *General Instrument Corp.* is now making a version here.

In all, at least two highly regarded FM tuners, in kit or wired form, employ this general type of one-tube wonder for the first two stages, and relatives of it are being used regularly in the FM lines of such manufacturers as *Admiral, Motorola,* and *RCA-Victor*—to name just a few. Now is the time to find out what the fuss is all about.

Distinctive feature of all circuits in this multiplying family is the use of one triode section as an r.f. amplifier and the other as an autodyne converter—that is, a self-oscillating converter. Some latter-day versions add an a.f.c. loop that connects to the separate FM detector at one end. At the other end, it goes to the oscillator tank through a semiconductor diode. If earlier versions are any criterion, this feature may be no more than a frill to enhance "sell" appeal. Without it, the front end is a package combining smooth tuning with commendable sensitivity and frequency stability.

Despite the praiseworthy performance, these streamlined tuner assemblies will evoke a big "Ouch!" from many a technician who must work on them. Unconventional circuitry, frequently coupled with physical considerations that are just as unfamiliar, may cause collective jitters until all concerned know what is involved. The time to learn is now.

In the particular circuit (Fig. 1) treated here, a foreign twin-triode, the ECC85, is used. Our equivalent is the 6AQ8. Virtually any of the similar twin r.f. triodes employed in cascode-type TV front ends can be, or has been, used. This includes the 6BQ7, 6BZ7, 6DT8, other types, and counterparts of each of these that carry other filament-voltage ratings.

The first triode section is always an r.f. amplifier. The one illustrated is a neutralized triode with signal input to the grid. Adjustment of the neutralizing trimmer can be touchy. More on this later. It is comforting to note that more recent versions eliminate this capacitor—and the need for it—by using a grounded-grid configuration with the signal applied to the cathode, as is done in many cascode TV tuners. The second triode section is the autodyne converter.

Signal from the antenna is applied to the balanced input network at the extreme left of Fig. 1. Antenna-matching transformer L_1 is a fixed-tuned affair presenting a low impedance to incoming signal and providing broad enough bandwidth to cover the full FM band.

Following the amplified r.f. signal to the plate, we encounter the neutralizing trimmer, C_7. Its purpose is to cancel the effect of internal tube capacitances, which might otherwise produce oscillation. Tube replacement, a circuit defect, or uninformed tampering with the adjustment may cause either oscillation or reduced sensitivity. This point will be elaborated further in the article.

The second triode section is the eye opener. Designed around its three simple, active elements is the stable and efficient combined oscillator and the autodyne converter. Between the time that incoming r.f. leaves the first triode and the time that it leaves the second, it has been selected, beat against an oscillator, and accurately altered to a signal of good amplitude at the intermediate frequency.

Many, especially old-hands at electronics, will recall the regenerative detector popular in by-gone radio days with its tickler coil and regeneration control. Here, with some differences, we have the beginning of the autodyne converter used here. In the latter circuit, it appears that circuit elements found respectively in the plate and grid have been switched around, as compared with early regenerative detectors. The *LC* constants that make up the oscillatory tank, which one might expect to find in the grid, are actually in the plate. The tickler coil, associated with the plate, is tied to the grid. Confusing? Let's review some basic material.

Fig. 2A shows a basic inductor-capacitor resonant circuit. The battery and switch have been added simply to provide the electrical impetus to start oscillation. If the switch is positioned so that the battery is connected across the capacitor, C_1 will be charged. Flicking the switch to the other position will then remove the battery from the circuit, leaving us with a closed circuit consisting of the charged capacitor and inductor L_1.

Oscillatory action now takes place. Voltage stored on C_1 by the battery discharges into the windings of coil L_1. As this voltage or e.m.f. builds up in the coil, the magnetic field around L_1 develops a reverse e.m.f. in this component, which then causes current to flow back to the capacitor, charging the latter in the opposite polarity to the original charge. In this way, current continues to flow back and forth between the capacitor and the coil, at a rate or frequency determined by the values of the two components. Hence, oscillation.

Since there is inevitably some resistance in the *LC* network too, the oscillatory energy is dissipated across this resistance, and oscillation soon dies out. However, we can introduce another force to sustain the oscillation as long as we like. An added electrical force or "push" to do this can be provided if we use a vacuum tube, as in Fig. 2B. Our simple resonant circuit is now coupled to the tube's grid. Operating voltage applied to the tube provides the starting impetus, in place of the battery. Oscillations in the grid circuit also appear at the plate. In the plate circuit we have tickler coil L_2, through which the oscillating plate current passes. L_2 is coupled to L_1 in such a way that it transfers the correct amount of oscillatory "push" in the correct phase (regenerative) right back into the resonant *LC* tank to keep oscillation going.

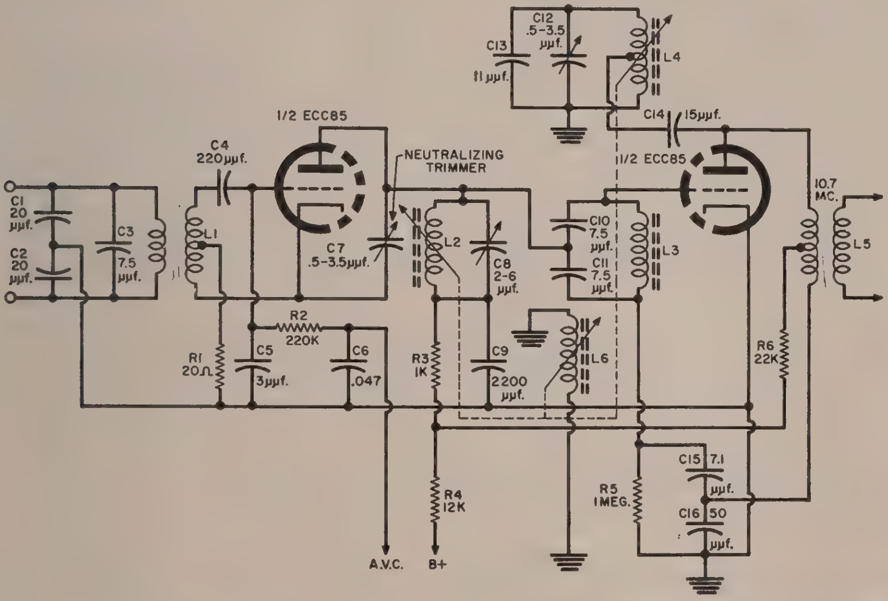
To this point, we have a not too complicated regenerative oscillator. At first glance, it may be hard to see that this arrangement is used in Fig. 1. As a matter of fact—as was said—the resonant *LC* tank, consisting of L_4 shunted by C_{12} and C_{13}, is in the plate. Tickler coil L_3, transformer-coupled to the oscillator tank, is in the grid. Thus the basic requirements for virtually any vacuum-tube oscillator, regardless of type, are fulfilled: continuing operation is maintained by feeding back the right kind and amount of restoring force to make up for losses.

Before going into further details about the oscillator itself and other circuitry, we should stop to consider the matter of frequency stability, including drift. Since oscillator frequency is determined mainly by the *LC* constants of the circuit; that is by the accumulated inductive and capacitive elements, a shift in frequency is principally brought about by changes in either or both of these elements. This would broadly include such a factor as vibration within a tube, which involves a capacitive change, or change in a coil's inductance as its temperature increases. Voltage variations in the oscillator circuit may also cause frequency to alter, but even here we may be coming back to the same factors. The changing voltage itself is the probable result of differences in circuit loading conditions, which are in turn affected by components whose characteristics do not remain constant as they heat.

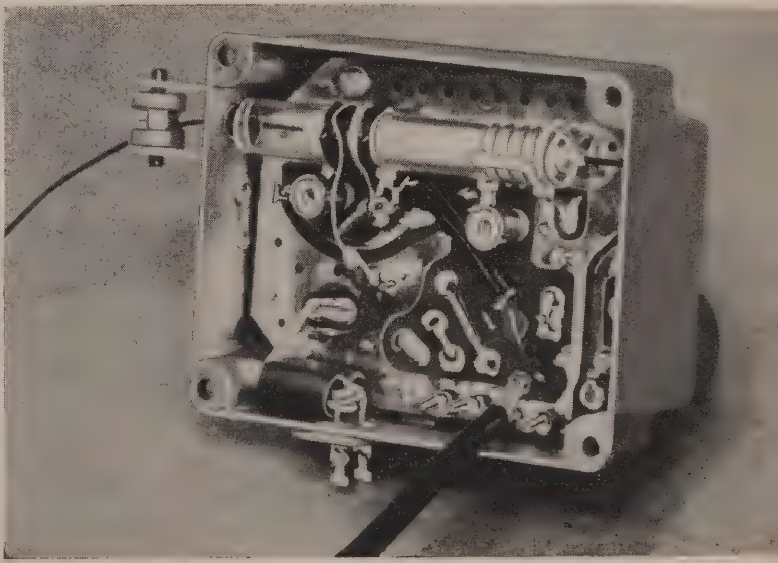
One way of dealing with drift, preventing it before it starts, is to maintain constant temperature, which is impractical. Compensating for drift is another approach, as with the familiar use of capacitors having negative temperature coefficients. These decrease in value as they grow hotter, rather than increasing, thus tending to cancel out the direction of other accumulated changes. This is part of the story in most versions of the autodyne converter, but not all of it.

It is also possible to ruggedize a stage and the components in it to make them relatively insensitive to alteration with temperature. These techniques are also used in many of the autodyne front ends. For example, coils may be wound of specially fabricated wires that consist of alloys that are scarcely affected by heat. The cross section of the wires may be other than a circle so that, when the coil becomes warmer, the relationship between the wound layers remains the same, preventing the inductor's internal capacitance from going off.

It is also possible to use a circuit or device for locking the frequency of the oscillator electronically. A resonant crystal is one such device, and an excellent one. However, we are not dealing with a fixed-frequency oscillator, but with one that must be changed in step with the r.f. being received. A fixed crystal is therefore out of the question.



▲ **Fig. 1. Specific circuit of the autodyne front end as used in the Telefunken "Jubilee" and other FM receivers.**



▶ **This underchassis view of the General Instrument unit shows the printed wiring used in the domestic version. Slug of the tuning coil at the top is connected to the dial cord.**

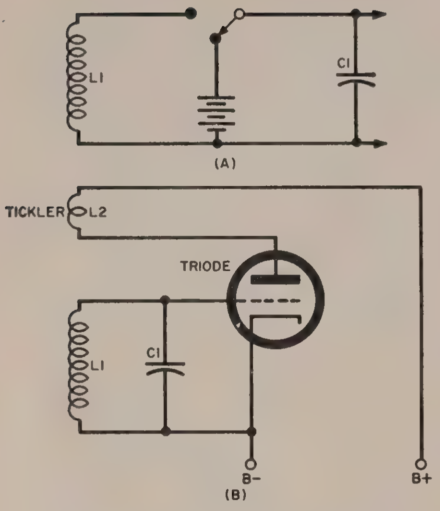
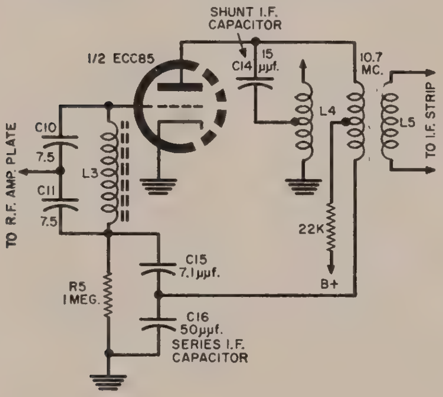


Fig. 2. (A) Basic oscillatory circuit. (B) A regenerative tube oscillator.

Fig. 3. This extract from Fig. 1 highlights oscillator section of circuit. ▶

Fig. 4. Another extract from Fig. 1 highlights the i.f. output circuit.

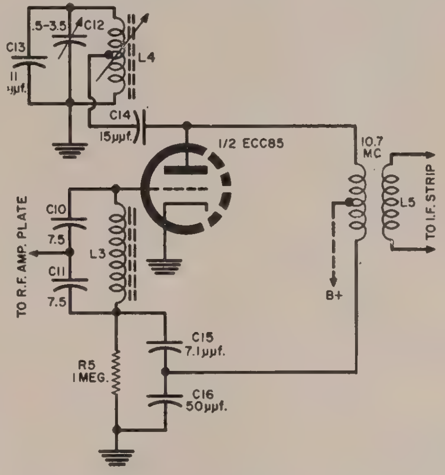


It would be excellent indeed if the receiver could be electronically "locked" to the signal being received to solve drift problems. Something of this sort is involved when separate a.f.c. circuits are used. Although the twin-triode front end does not have a readily recognizable a.f.c. arrangement of the conventional kind, another means is used for obtaining some automatic frequency control. This can be clarified with reference to Fig. 3, a separate, simplified schematic of the basic oscillator portion of the complete design. Before we get into this, we are confronted by the fact that many interrelated functions go on at the same time and much interaction exists between various portions of the circuit. It is therefore advisable to study the handling of r.f. signal in more detail at this point.

We have noted that r.f. from the antenna passes through transformer L_1 to the grid of the first triode, and that it appears amplified at the plate. It is then selected by the slug-tuned plate *LC* network, consisting mainly of L_2 and C_8. From here it goes to the grid of the oscillator-converter—but *how* is not so simple.

The capacitive voltage divider, consisting of C_{10} and C_{11} in Figs. 1 and 3, might seem to couple r.f. to the second-stage grid. Actually, equal amounts of r.f. signal are fed to the top and bottom of L_3 in the *same* phase by the divider action. Thus, this *prevents* the r.f., which is cancelled out in L_3, from appearing across that coil. Actually r.f. is not wanted at this component. Remember that the main role of L_3 is that of the tickler coil to sustain the oscillator, at another frequency.

The real path of incoming r.f. signal is from the tank in the plate of the first triode, through capacitor C_{10} only, to the second triode's grid. One might say that this was worked out first and that C_{11} was added to provide bucking action, as some r.f. signal applied to the grid might otherwise sneak away down coil L_3.



This matter of blocking r.f. signal out of the tickler coil also serves another function. There is considerable coupling between components in the oscillator and converter triode of this compact design and those of the r.f. selective tank in the first triode, and it works two ways. Oscillator signal could be coupled back to the first triode and radiate excessively from the front end and antenna system, causing interference problems. This is also prevented by the blocking arrangement, which provides the isolation that forestalls oscillator radiation.

The oscillator tank itself, which we have noted already as being in the plate circuit of the second triode, is relatively simple. It consists of L_4 shunted by C_{12} (adjustable to establish correct tracking) and fixed capacitor C_{13}. L_4 is mechanically ganged with r.f. selector coil L_2 for manual tuning.

The resonant circuit just described is coupled to the plate of the second triode simply through C_{14}. Characteristic of the economical design practice followed throughout, C_{14} also serves another function, which can be seen more clearly by examining the partial schematic of Fig. 4. Here another resonant circuit, the i.f. take-off, is highlighted. As is customary, the intermediate frequency shown is 10.7 mc. The i.f. transformer is L_5, and its primary is resonated with other components—largely capacitive, of course—to 10.7 mc. C_{14}, already doing one job, also acts as the shunt capacitor for the i.f. tank. It returns to ground through a part of L_4. C_{16} is a series i.f. capacitor, although this component also has other functions to which we shall soon refer.

A fairly good idea of how the front end works in general should be in focus now. We have followed the introduction of the r.f. signal, its amplification in the first triode, and its application to the grid of the second triode, to which point the oscillator tank is connected. Operation of the oscillator has also been discussed. After mixing of the two signals in the second triode, we note the i.f. output circuit through which the 10.7-mc. carrier is then coupled to the i.f. strip. Nevertheless, there are still portions of the circuit and functions that have not yet been taken into account. For example, the matter of drift, mentioned earlier and then dropped, has yet to be considered fully. Other points can also benefit from clarification.

A self-resonant, tunable trap, grounded at both ends (L_6), is transformer-coupled to the oscillator, which it loads to some extent. It helps to prevent cutting off the converter stage by excessive drive from the oscillator. This feature does not appear to be necessary in all versions of the autodyne front end, as it is omitted in many.

Another branch of the circuit, which does appear to be used in all versions, consists of capacitors C_{15} and C_{16}, shown as part of the oscillator circuit in Fig. 3. Actually one role of C_{16}, as a tuning capacitor in the i.f. output circuit, has been highlighted. Like many components in this streamlined design, it does more than one job. The values shown for C_{15} and C_{16} are carefully chosen so that a specific ratio exists between them. Thus for any a.c. voltage appearing across this combination, the capacitors form a voltage divider, whose action serves to stabilize operation and output of the oscillator.

Aside from its job in this capacitive divider, C_{15} also has another job to do—and here we finally return to the matter of drift. Note that this capacitor is an important link in a loop that goes from the primary of i.f. transformer L_5 to the grid of the second or oscillator triode, through L_3. This feedback path is the one that adjusts oscillator frequency automatically should there be any tendency to drift.

With L_5 tuned exactly to 10.7 mc., the greatest r.f. voltage will be developed across it when the i.f. is exactly 10.7 mc., as it should be. If the oscillator should tend to drift off frequency, then the heterodyned i.f. output will also tend to move away from 10.7 mc. If it does, the voltage drop across the resonant 10.7 mc. tank also changes. Feedback capacitor C_{15} applies some of the i.f. voltage back to the oscillator.

(*Continued on page* 130)

STEREO AMPLIFIER CONTROLS—
and what they do

By **HERMAN BURSTEIN**
Author, "Stereo—How It Works"

A good over-all summary of the functions of the various operating controls that are used in a stereo system setup.

THE stereo amplifier has a dual task: to coordinate two program channels in conventional functions, such as selection of input source, gain control, equalization, etc.; and to perform certain functions unique to stereo. We are talking essentially about control amplifiers, although most of the following discussion also pertains to integrated equipment such as a control amplifier combined with a power amplifier or with a tuner.

The stereo amplifiers of various manufacturers differ to some extent in the functions they provide. In choosing among stereo amplifiers, the prospective purchaser must consider what features are apt to meet his needs. An understanding of the controls and functions commonly found in these units will facilitate his choice. The first control discussed is the balance control.

Unique to stereo is the balance control (sometimes called a focus control) permitting the level of either channel to be increased relative to the other by means of a single knob. Fig. 1 shows the basic principle of many balance controls, enabling the level of one channel to increase as the other decreases so that total volume remains nearly constant.

Whereas Fig. 1 employs two ganged potentiometers, it is possible to control balance by means of one pot, as shown in Fig. 2, where the arm causes one channel or the other to be shorted to ground as it moves up or down. The values shown in Fig. 2 will maintain the combined sound level of the two channels reasonably constant as the control is rotated.

The range of action of the balance control varies greatly among stereo amplifiers. In some, maximum rotation of the control produces as little as 6 to 10 db difference in level between channels, while in others the difference is as much as 40 db, or even greater. Fig. 1 permits an infinite difference. Fig. 3 shows how the range can be limited by inserting a resistance between each pot and ground. Fig. 2 also permits an infinite difference, while Fig. 4 shows how this circuit can be modified to limit the maximum difference between channels.

The ratio between highly efficient and quite inefficient speakers is roughly 20 to 1, or 13 db. Power amplifier sensitivities differ by as much as 14 db (one amplifier may be driven to 10 watts by .2 volt, while another may require 1 volt). The two sections of a stereo cartridge may differ in output level by 3 or 4 db. The two channels on a stereo disc or tape may differ by several db. All told, it is possible for these differences to add up to a very considerable total, so that a balance control with a range of action approaching 40 db may prove useful, assuming the stereo installation comprises unmatched power amplifiers and unmatched speaker systems.

But if one employs matched power amplifiers and matched speaker systems, the need for a wide-range balance control diminishes. A range of 10 db or less can then be satisfactory. Moreover, the limited-range control has the advantage of a finer vernier, which makes accurate channel balancing easier.

Master Gain Control

Once the stereo system is adjusted for balance between channels, it is important that the listener be able to change total volume without upsetting channel balance. Therefore, most stereo amplifiers contain a master gain control, as in Fig. 5, consisting of two pots operated by a single shaft.

A few stereo amplifiers have, instead, individual gain controls for each channel, but concentrically mounted so that by rotating both together one achieves the effect of a master gain control. It is usual practice, then, to use concentric shafts that lock together when the inner shaft is pushed in slightly.

The change in balance that occurs when rotating the master gain control is called "tracking error." This should be no more than ±3 db, and preferably no more than ±1 db. Conventional pots mounted on a single shaft may produce errors much greater than ±3 db, due to differences in taper between the pots. The tracking error can be kept within suitable bounds by the following means:

1. Employ pots manufactured to close tolerances. This is expensive.
2. Employ conventional pots, selected to form matched pairs with closely similar tapers.
3. Employ pots with taps, as in Fig. 6, to bring the two pots into correspondence at a number of intermediate points between minimum and maximum rotation.
4. Employ stepped controls, as in Fig. 9. Resistor values are usually chosen so that going from one switch position to the next produces a level change of about 2 or 3 db. Tracking error can be kept well under 1 db by this method, however, it is quite expensive and has a limited range of attenuation due to the finite number of switch positions.

Gain controls are best located at an early stage in the amplifier in order to reduce the signal before it can drive a stage hard enough to cause appreciable distortion. It is desirable to have the balance control as well as the gain control at an early stage, thus the master gain and balance controls are often brought together, as shown in Fig. 7.

Tone Controls

It is still a moot question whether separate or ganged bass and treble controls should be incorporated in a stereo amplifier. The ganged control simplifies operation and appearance and, if matched speaker systems are employed, the chances are reasonably good that this type of control will provide enjoyable listening.

Individual controls, however, afford greater flexibility. If different loudspeakers are used for the two channels, different amounts of bass and/or treble correction may be required in each channel to achieve best results. Even when using matched speakers, their location and orientation with respect to the listener may call for varying tonal correction. Differences in the signal for each channel, as in the case of FM-AM stereo, may also call for different bass and/or treble adjustment. Yet with further advances in the art, including the transition from FM-AM stereo broadcasts to FM multiplex ones, increased use of matched speaker systems, and greater uniformity of frequency response between channels on stereo discs and tapes, it may be expected that the present advantages of separate tone controls will probably diminish.

Channel Switching

Stereo amplifiers provide various switching functions to permit balancing channels, listening to monophonic sources, correcting for errors in phasing or channel identification (left *versus* right), etc. Most stereo control amplifiers provide most of the following functions, although few provide all of them.

1. *Reverse Stereo:* This permits the left signal to be fed to the right channel and the right signal to the left channel, as shown in Fig. 10. While accidental reversal of channels on commercial discs and tapes can be expected to drop to zero, there is as yet no stand-

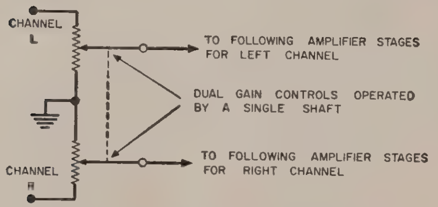

CHANNEL L
TO FOLLOWING AMPLIFIER STAGES FOR LEFT CHANNEL
DUAL GAIN CONTROLS OPERATED BY A SINGLE SHAFT
TO FOLLOWING AMPLIFIER STAGES FOR RIGHT CHANNEL
CHANNEL R

Fig. 1. Here is the circuit arrangement employed in a basic balance control hookup.

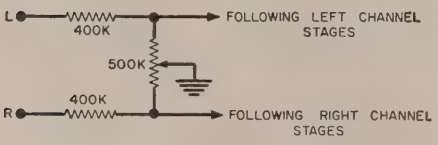
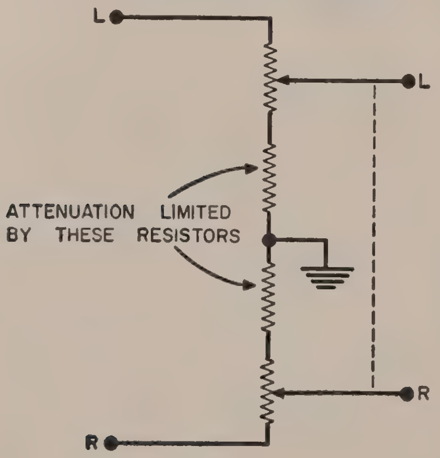

L
400K
FOLLOWING LEFT CHANNEL STAGES
500K
R
400K
FOLLOWING RIGHT CHANNEL STAGES

Fig. 2. Single control for balancing.

Fig. 3. A balancing arrangement that employs a limited amount of attenuation.


L
L
ATTENUATION LIMITED BY THESE RESISTORS
R
R

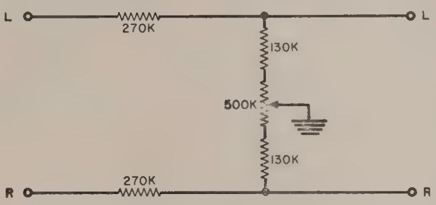

L
270K
L
130K
500K
130K
270K
R
R

Fig. 4. Single control for channel balancing with limited (about 10 db) attenuation.

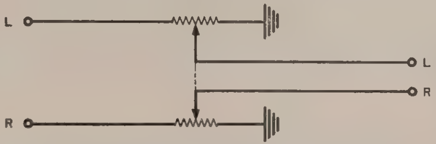


Fig. 5. A typical basic master gain control.

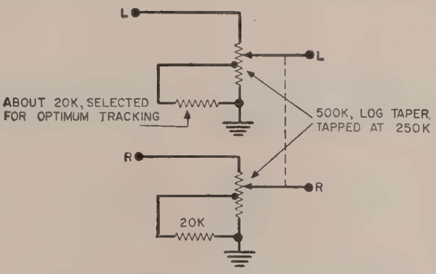

L
L
ABOUT 20K, SELECTED FOR OPTIMUM TRACKING
500K, LOG TAPER, TAPPED AT 250K
R
R
20K

Fig. 6. Tapped controls for good tracking.

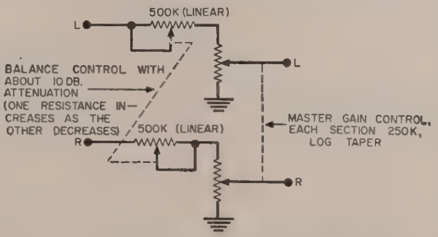

500K (LINEAR)
L
L
BALANCE CONTROL WITH ABOUT 10 DB. ATTENUATION (ONE RESISTANCE INCREASES AS THE OTHER DECREASES)
500K (LINEAR)
R
MASTER GAIN CONTROL, EACH SECTION 250K, LOG TAPER
R

Fig. 7. Combined balance and master gain.

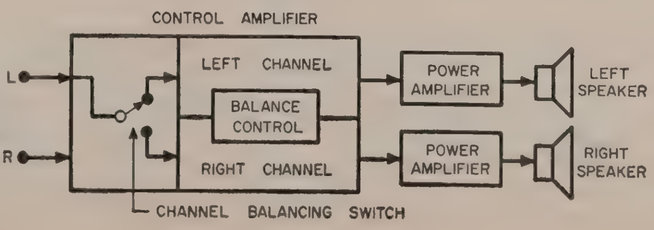

CONTROL AMPLIFIER
L
LEFT CHANNEL
BALANCE CONTROL
RIGHT CHANNEL
R
POWER AMPLIFIER
LEFT SPEAKER
POWER AMPLIFIER
RIGHT SPEAKER
CHANNEL BALANCING SWITCH

Fig. 8. The system diagram at the right shows hookup that may be employed for channel balancing. See text for operation details.

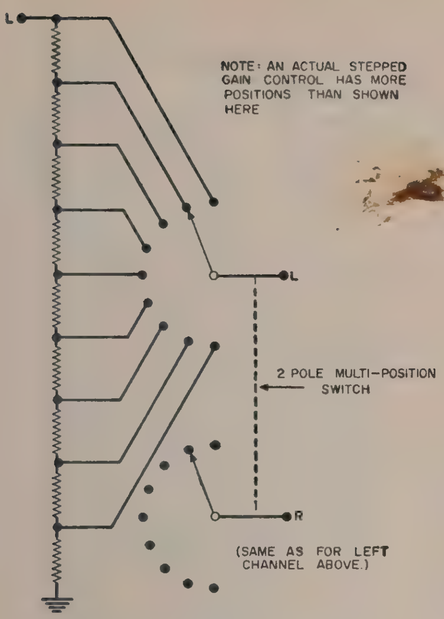
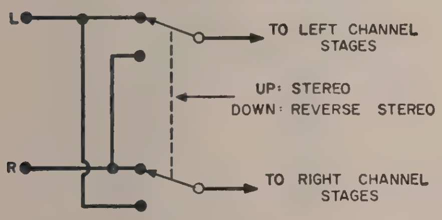

L
NOTE: AN ACTUAL STEPPED GAIN CONTROL HAS MORE POSITIONS THAN SHOWN HERE
L
2 POLE MULTI-POSITION SWITCH
R
(SAME AS FOR LEFT CHANNEL ABOVE.)

Fig. 9. Stepped master gain control.

Fig. 10. Reverse-stereo switching.


L
TO LEFT CHANNEL STAGES
UP: STEREO
DOWN: REVERSE STEREO
R
TO RIGHT CHANNEL STAGES

ardization with respect to left-right orientation of FM-AM stereocasts. Also, amateur stereo tape recordists will probably make mistakes. (For a tape traveling from left to right, the upper track should contain the left channel signal.) Finally, the experimentally inclined stereophile will undoubtedly be curious as to the effects of reversing channels; conceivably, for some types of program material or for certain listener locations, the results may be beneficial.

2. *Balance Switching:* This permits one of the signals, say the left, to be fed either to the left or right channel, as shown in Fig. 8. Alternate switching of one signal to either channel facilitates balancing the sound levels of the two speaker systems. If the stereo amplifier incorporates reverse switching, separate balance switching is not strictly necessary, because reverse stereo accomplishes the same thing provided one disconnects one of the signals (say the right) from the amplifier. However, having to remove one of the signal sources may prove inconvenient, as for example when playing a stereo disc.

3. *Monophonic Disc Switching:* This combines the left and right signals and feeds the sum signal to both channels, as illustrated in Fig. 11. This is desirable when playing a monophonic disc with a stereo cartridge because the audio (lateral) signals are added in-phase, while the rumble (vertical) signals are added out-of-phase, causing substantial cancellation of vertical rumble, which is often a considerable problem when using a stereo pickup.

4. *Quasi-Stereo Switching:* This feeds the left (or right) signal to both channels, as shown in Fig. 12, permitting one to hear a monophonic source on both speaker systems, thus providing a quasi-stereo effect. While a system that provides monophonic disc switching (Item 3) in a sense also permits quasi-stereo switching, the reverse is not true. For example, some stereo amplifiers can feed the left signal to both channels but they cannot also feed the right signal to both channels. To sum up, it may be desired to feed *both* signals to *both* channels (monophonic disc switching) or it may be desired to feed *one* signal to *both* channels (quasi-stereo).

5. *Phase Reversal:* This permits the phase of one channel to be reversed 180 degrees. If the stereo amplifier is an integrated unit, containing power amplifiers, this can be accomplished by simply reversing the leads to one set of speaker terminals, as shown in Fig. 13. If the unit is solely a control amplifier, phase reversal must be accomplished electronically, as shown in Fig. 14, by an extra tube stage. The unwanted amplification is offset by a voltage attenuator, either a voltage divider at the grid, as shown in Fig. 14, or a feedback circuit from plate to grid. While disc and tape program sources are careful to maintain proper phasing, nevertheless the circumstances of microphone and speaker placement may cause phase relationships such that a change of 180 degrees on one channel will provide better listening. Improper speaker phasing, whatever the reason, will produce poor spatial orientation, especially of sounds supposed to emanate from an area about half-way between the two speaker systems.

Blend Control

The "hole-in-the-center" effect frequently encountered in stereo can be mitigated to some extent by feeding some of the right signal to the left channel and some of the left signal to the right channel. The blend control, Fig. 15, found in some stereo amplifiers (and sometimes called a dimension control) permits the listener to combine the two signals to any desired extent. Inasmuch as the two signals are combined at minimum position of the arm, an amplifier with a blend control can dispense with the monophonic disc switching feature described previously.

Phantom Channel Output

Another method of eliminating the "hole-in-the-center" is to combine the left and right signals and feed their sum to a center speaker. The com-

(*Continued on page* 122)

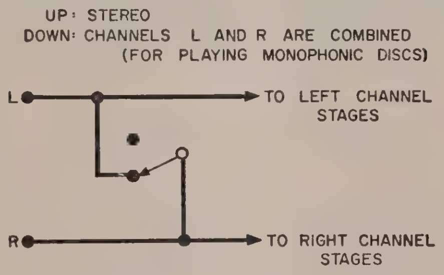

UP: STEREO
DOWN: CHANNELS L AND R ARE COMBINED (FOR PLAYING MONOPHONIC DISCS)
L
TO LEFT CHANNEL STAGES
R
TO RIGHT CHANNEL STAGES

Fig. 11. Switch for combining channels.

Fig. 12. Quasi-stereo switching setup.

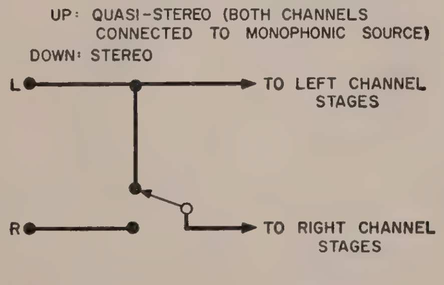
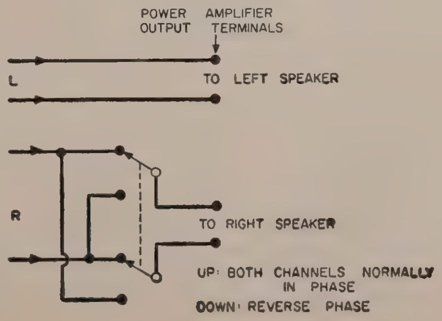

UP: QUASI-STEREO (BOTH CHANNELS CONNECTED TO MONOPHONIC SOURCE)
DOWN: STEREO
L
TO LEFT CHANNEL STAGES
R
TO RIGHT CHANNEL STAGES

Fig. 13. Phase-reversal switching setup.


POWER AMPLIFIER OUTPUT TERMINALS
L
TO LEFT SPEAKER
R
TO RIGHT SPEAKER
UP: BOTH CHANNELS NORMALLY IN PHASE
DOWN: REVERSE PHASE

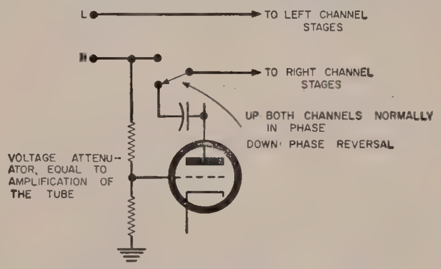

L
TO LEFT CHANNEL STAGES
R
TO RIGHT CHANNEL STAGES
UP: BOTH CHANNELS NORMALLY IN PHASE
DOWN: PHASE REVERSAL
VOLTAGE ATTENUATOR, EQUAL TO AMPLIFICATION OF THE TUBE

Fig. 14. Electronic phase reversal.

Fig. 15. Arrangement for blend control.

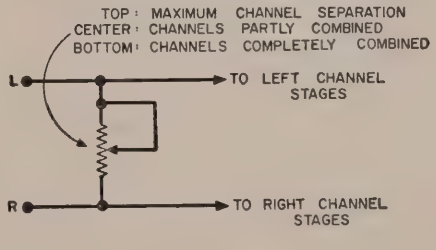
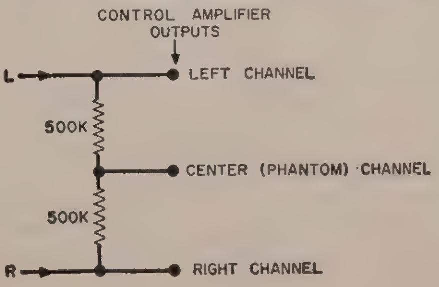
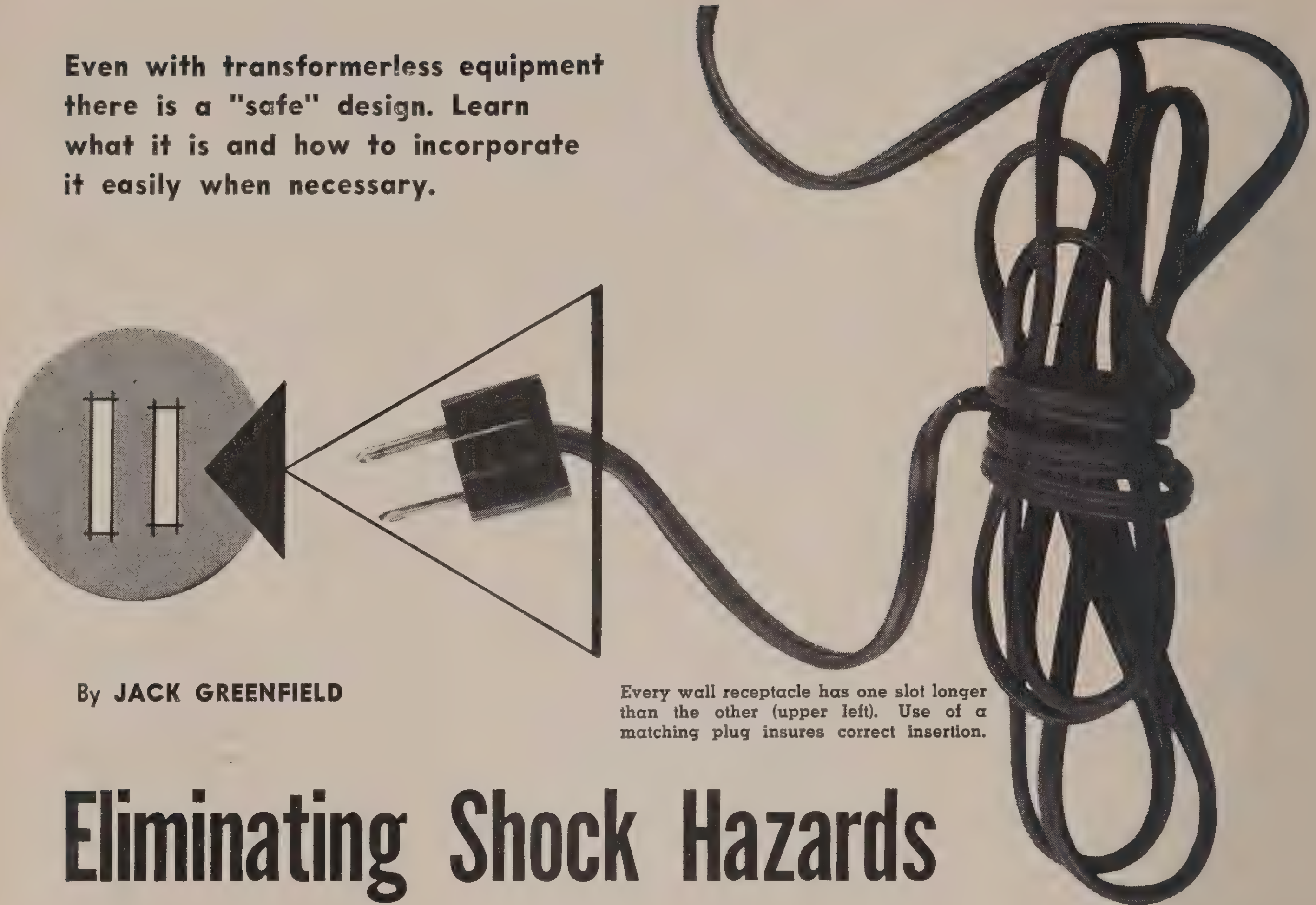

TOP: MAXIMUM CHANNEL SEPARATION
CENTER: CHANNELS PARTLY COMBINED
BOTTOM: CHANNELS COMPLETELY COMBINED
L
TO LEFT CHANNEL STAGES
R
TO RIGHT CHANNEL STAGES

Fig. 16. Phantom channel output circuit.


CONTROL AMPLIFIER OUTPUTS
L
LEFT CHANNEL
500K
CENTER (PHANTOM) CHANNEL
500K
R
RIGHT CHANNEL

Even with transformerless equipment there is a "safe" design. Learn what it is and how to incorporate it easily when necessary.



By **JACK GREENFIELD**

Every wall receptacle has one slot longer than the other (upper left). Use of a matching plug insures correct insertion.

Eliminating Shock Hazards

EDITOR'S NOTE: *It is scarcely a secret these days that many radios, TV sets, and other electronic devices that operate on line voltage may present shock hazards. (For that matter, so do many other plug-in electrical appliances, despite the fact that electronic equipment has been singled out for notoriety.) Here is an article that goes beyond exposing the condition. Simple, positive measures, which can be performed by the service technician to cut the hazard, are described.*

THE CIRCUIT designs of some a.c.-d.c. radios, TV receivers, phonograph units, and other equipment lacking power transformers present potential shock hazards to the consumer-operator. While this is well-known, few people are also aware that the danger may continue to exist even after the equipment is turned off. In fact, under certain conditions, the possibility of shock exists only when the equipment is off but not when it is on. These facts become somewhat more disturbing when one considers the confidence with which adults entrust children with such devices.

Nevertheless, there is one design technique for such equipment that is safe under all normal conditions. While some manufacturers use it, the evidence, based on many devices now in the hands of consumers, is that other companies have not given the problem sufficient attention.

Why this is so is a matter for speculation. Possibly too many commercial designs are based on untried, generalized circuits suggested in electronic literature over the years. Such suggested application designs are generally accompanied by warning notices to the effect that they have not been subjected to engineering review. However, such a note can be ignored easily. Home wiring is designed to conform to strict safety standards. It makes no sense for this safety to end at the wall receptacle.

The safe alteration of potentially dangerous a.c.-d.c. equipment is a service every radio-TV shop should offer. It should be a rule never to return such a device after service without advising the customer of the hazard and recommending conversion. Most customers approve the change if they are shown that the danger does indeed exist. This may be accomplished simply by connecting a voltmeter in the manner shown in the various illustrations accompanying this article.

To proceed intelligently with correction, the technician must recognize the differences between design alternatives and understand what makes one safe while another may be unacceptable. To establish what is meant by a safe design, at least one point must be clear. For optimum safety, all "chassis ground" surfaces that may be accessible to an operator must be maintained at earth-ground potential under all conditions of equipment op-

Table 1. Chassis-ground potential for "on" or "off" conditions in Figs. 1 to 4.

Input Power Ckt. Fig. No.	Type of Connection	Switch Condition	Chassis Potential to Earth Ground	Remarks
1	Chassis in hot line; switch in ground line.	Open (A)	Line voltage from chassis to earth ground.	Shock hazard in both conditions.
		Closed (B)	Line voltage from chassis to earth ground.	
2	Chassis in ground line; switch in ground line.	Open (A)	Line voltage from chassis to earth ground.	Shock hazard in "equipment off" condition only.
		Closed (B)	Chassis at earth ground potential.	
3	Chassis in hot line; switch in hot line.	Open (A)	Chassis at earth ground potential.	Shock hazard in "equipment on" condition only.
		Closed (B)	Line voltage from chassis to earth ground.	
4	Chassis in ground line; switch in hot line. Connection ensured by polarized plug.	Open (A)	Chassis at earth ground potential.	Safe under both conditions. ONLY APPROVED DESIGN.
		Closed (B)	Chassis at earth ground potential.	

eration, including the time the equipment is off.

There are two basic a.c.-d.c. circuit designs. For each, safety is affected by the two possible ways of connecting the equipment to the power receptacle. In addition, safety is affected by the two operating positions of the power-control switch. A survey of possible switch locations is included in Figs. 1 through 4.

The two basic designs, irrespective of other conditions, are illustrated in Figs. 1 and 2. Figs. 4 and 3 are of the same circuits as Figs. 1 and 2 respectively, but are shown with the line cords reversed in the power receptacle. Part (A) of each figure is shown with the power switch in the "open" condition: part (B) of each with the switch in the "closed" condition. The individual circuit diagrams incorporate voltmeter indications to show at a glance the critical readings between chassis and earth ground. Table 1 presents a summary of features to be discussed.

Fig. 1 presents the classic case in which danger from electrical shock exists under all conditions of equipment operation. The line cord is plugged into the receptacle in a manner that connects the equipment chassis directly to the hot side of the power line. Operation of the power switch to either the open or closed position does not succeed in removing the connection between chassis and the hot line because the switch operates in the ground line. The operator of equipment wired in this manner who comes into contact with the chassis while also in contact with a source of earth ground (plumbing in the home, etc.), will inevitably receive an electric shock.

Fig. 2 is the case in which danger from electric shock exists only in the "equipment off" condition. In this case the line cord is plugged into the receptacle in a manner that connects the hot side of the power line to the equipment load. With the switch open, the ground line is open and the hot line potential is applied to the chassis. When the power control switch is closed, the ground side of the power line is connected to the equipment chassis and the operator touching the chassis or its exposed metal parts is safe from electric shock. The effect of shock with the switch off in this case may be less severe than in the case of Fig. 1, incidentally, since the circuit load drops some of the available voltage and limits the current when the body completes the path to earth ground.

Fig. 3 illustrates the case in which danger from electric shock exists only in the "equipment on" condition. Here the line cord is plugged into the receptacle in a manner that connects the hot side of the power line to the chassis when the switch is closed. With the switch open, the hot line is not connected to the equipment at all and the chassis is effectively at earth ground potential.

At this point in the discussion, it should appear that a safe design in both "equipment on" and "equipment off" conditions of operation would have to combine the properties of the circuit shown in Fig. 2B with those of the circuit shown in Fig. 3A. Fig. 2B was safe because the chassis was connected to the ground side of the power line when the equipment was on. Fig. 3A was safe when the equipment was off because the power-control switch was wired into the side of the circuit that was connected to the hot side of the power line. In the open position, the power-control switch completely removed the connection between the equipment and the hot side of the power line.

A circuit that combines the better characteristics of the circuits in Figs 2B and 3A is shown in Fig. 4. This configuration places the chassis in the leg of the circuit connected to the ground side of the power line, and places the power-control switch in the leg of the circuit connected to the hot side of the power line. Careful examination will indicate that this arrangement, exclusive of the polarity of the connection to the power receptacle, is identical to the "dangerous" design shown in Fig. 1. Note therefore that, once the desired design is chosen, safety becomes dependent on the polarity of the connection made to the power receptacle.

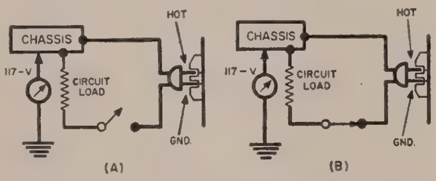


Fig. 1. With power-switch location shown, shock hazard is always present.

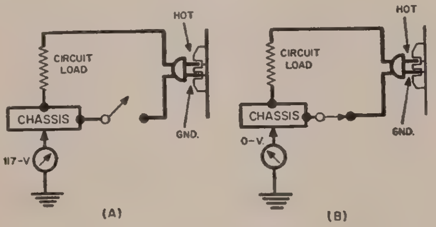


Fig. 2. In this arrangement, chassis is hot only when equipment is turned off.

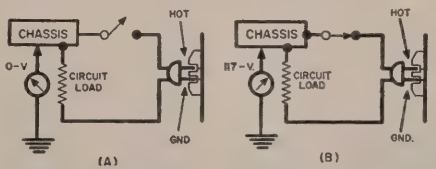
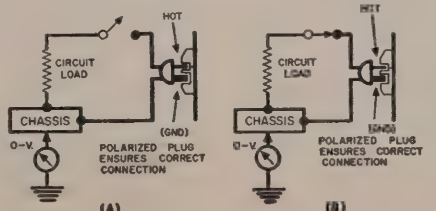


Fig. 3. This circuit presents a shock potential only when the equipment is on.

Fig. 4. With arrangement shown, chassis is cold whether equipment is on or off.


HOT
CIRCUIT LOAD
CHASSIS
(GND)
0-V.
POLARIZED PLUG ENSURES CORRECT CONNECTION
(A)
HOT
CIRCUIT LOAD
CHASSIS
(GND)
0-V.
POLARIZED PLUG ENSURES CORRECT CONNECTION
(B)

To ensure that equipment of inherently safe design is truly safe under all conditions, it is necessary to eliminate the possibility of connecting the equipment to the power receptacle incorrectly. This may be accomplished quite simply through the use of a polarized plug. This plug is effective because all modern power receptacles are polarized. Observation will indicate that the home wall receptacle employs intake slots of different widths. Home wiring is arranged so that the earth ground line is universally connected to the wider slot, the hot line to the narrower slot. Equipment that incorporates a polarized plug matches the wiring arrangement in the receptacle by a scheme whereby the equipment chassis is connected to the wide prong of the polarized plug, and the power control switch to the narrow prong.

While polarized plugs are manufactured and sold, they may not be readily available in all locations. However, it is easy to alter a conventional plug to conform to the requirement. This may be done with a small loop of wire open at one end, which is soldered around the edge of the prong that is to be returned to chassis. One convenient source of such a loop is a conventional paper clip. If the larger, outer loop from such a clip of the most popular size is used, it will be suitable.

To insure a good bond, use a 100-watt soldering iron and pre-tin both the prong on the plug and the wire loop. Be sure to use enough solder. The prong can be filed to shape after this operation to make sure that the plug will fit in the receptacle snugly but without forcing. To check the effectiveness of this safeguard, attempt to insert the plug in the receptacle in the reverse position. It should *not* fit.

The entire conversion may be accomplished in three simple steps: 1. Polarize the line-cord plug, in either of the two ways described. 2. If necessary, re-wire the power "on-off" switch so that it opens and closes the hot line of the power cord; that is, the line that is to be connected to the narrower prong of the plug. 3. Make sure that the ground side of the power cord (the line connected to the wider prong of the polarized plug) is connected to the equipment chassis.

Technicians who point out the need for such conversions to their customers and urge that the job be done are performing a service to all involved, including themselves. Not only are these simple changes a source of revenue, but they protect the technician against unfair charges of responsibility where a shock has been incurred by the equipment owner after the device has been returned from the service shop. The accompanying table and illustrations provide a reference for rapid evaluation and correction of line-operated home-entertainment instruments. —30—

Transistorized Phono Preamp for Stereo

By **FRANCIS A. GICCA**/Raytheon Co.

Construction of high performance, low-cost preamplifier for magnetic stereo cartridges that affords the maximum response. Design features minimum shunting capacitance.

THE most critical components in a stereophonic disc reproducing system are the stereo cartridge and its associated preamplifier. Unless these two components deliver maximum performance, the finest amplifiers and speakers cannot hope to produce true stereophonic fidelity. If a stereo cartridge can inherently reproduce the entire audio spectrum with high fidelity, then it is obvious that its preamplifier must not destroy this fidelity or add hum, noise, or distortion of its own. This article will cover the development of a preamplifier designed to achieve optimum performance with magnetic stereo cartridges.

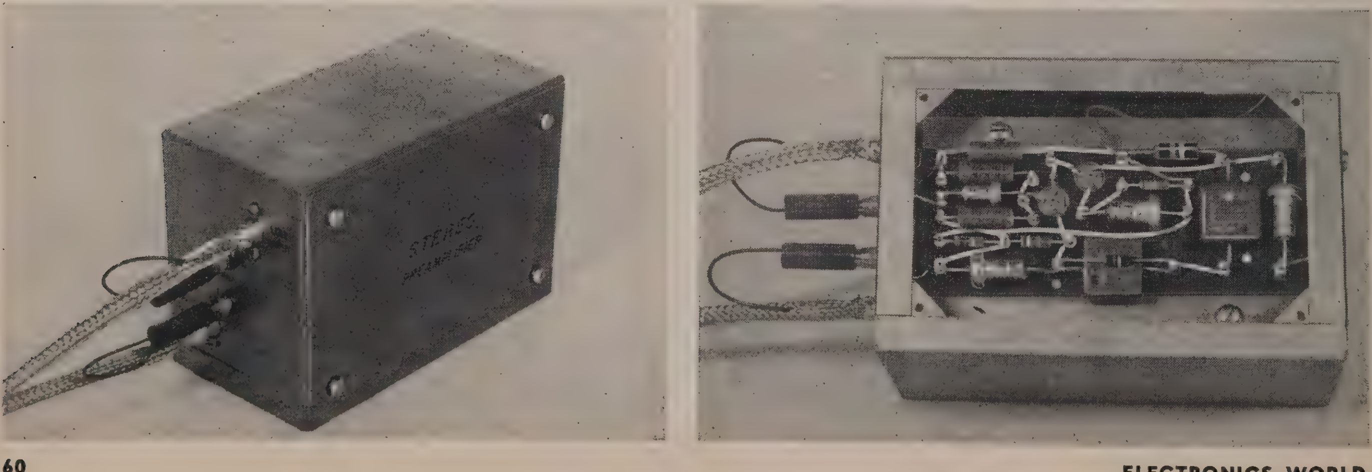
By their very nature, magnetic stereo cartridges have low outputs in the 1 to 10 millivolt range. At 60 cps, RIAA equalization requires a bass boost of 16 db. This bass boost, coupled with the stereo cartridge's low output, can easily lead to serious hum in the preamplifier unless the initial design overcomes this inherent problem. The obvious solution is to completely isolate the preamplifier from a.c. fields by either using a highly filtered d.c. heater supply in a vacuum-tube preamp or by eliminating tubes and using transistors. The latter approach is preferable since transistors are inherently hum-free and the expense of a low-ripple d.c. heater supply is avoided. Therefore, it was decided that the best low-hum preamplifier could be built using transistor circuits.

In order to extract the smoothest and widest frequency response from a magnetic cartridge, it is vital that the preamplifier offer optimum loading for the cartridge. Unfortunately, a basic conflict exists in trying to load a magnetic cartridge properly by resistive means alone.

Fig. 1A shows the basic equivalent circuit for a magnetic cartridge, its cabling to the preamplifier, and the preamplifier loading. At frequencies below cartridge resonance, shunt capacities may be neglected, yielding the equivalent circuit of Fig. 1B. This circuit is essentially a low-pass *RL* filter whose response is down 3 db at $f = (R_c + R_L) / 2\pi L_c$. In order to prevent a droop in response in the audio band, this corner frequency must be above the highest frequency it is desired to reproduce. This, in turn, requires that $R_c + R_L$ be greater than $2\pi L_c$ at this frequency, which requires a large value of R_L since R_c is fixed by the cartridge chosen and is generally a low value. Unfortunately, a high value R_L can cause excessive thermal noise in the preamplifier, generated by thermal agitation in this large resistor. This leads to the first conflict; a large value R_L for minimum low-pass filter effects, but a small value of R_L for minimum thermal noise generation.

Consider the high-frequency resonant equivalent of Fig. 1C. Here the cartridge appears like a resonant *RLC* circuit which exhibits the resonant response shown. If R_L is large, then the resonant peak will be correspondingly large. If the resonant peak occurs in the audio band, due to high cable and preamplifier capacitance, the resonant peak should be made as small as possible through the use of a low value R_L in order to keep the response smooth. If at all possible, the resonant peak should be kept out of the audio band since cartridge output drops off rapidly above resonance. These facts suggest that the value of R_L should be kept low, as should cable and preamplifier capacitance. This, again, is in conflict with the requirement of a large value of R_L for minimum low-pass

Over-all and internal views of the preamplifier. The interior view, taken with one of the chassis side panels removed, shows the underside of one of the two wiring boards used in the construction.



filter effects. For an excellent discussion of cartridge loading see "Loading the Phono Cartridge" by Herman Burstein, RADIO & TV NEWS, November, 1958.

Because of these conflicts in a choice of loading resistance, many cartridge manufacturers recommend a value of loading resistance which compromises low-pass and resonance effects. Fortunately, there is a solution to this dilemma which is not a compromise and affords maximum response from all cartridges.

If cable and preamplifier capacitance can be reduced to only one or two micromicrofarads, then cartridge resonance will occur well above the audio spectrum and R_L can be increased indefinitely since the resonant peak will be inaudible. A large value of R_L then places low-pass filter effects outside the audio band.

However, R_L must be kept physically small in order to minimize thermal noise. This appears to conflict with the foregoing but it need not if a physically small resistor is *electronically* multiplied in value to appear like a large resistor. Fig. 2A shows how this may be accomplished. Transistor V_1 is connected as an emitter-follower, which is roughly equivalent to a vacuum-tube cathode-follower. If the emitter-follower has an a.c. gain of 0.9, then the a.c. output voltage (E_o) across R is 0.9 E_i, the input voltage. An impedance Z is connected between input and output. Summing voltage drops around the input yields: $E_i = IZ + 0.9\ E_i$ or $0.1\ E_i = IZ$. The input impedance seen across terminals 1 and 2 is then $E_i/I = 10Z$. This shows that the effective impedance seen across terminals 1 and 2 is ten times greater than the actual impedance Z. If Z is a resistor, then ten times this resistance is seen across terminals 1 and 2. If Z is a capacitor, then one-tenth its capacitance is seen. If the gain of the emitter-follower is 0.99 instead of 0.9, then 100 times Z is seen at the input.

This is exactly what is desired since effective capacitance is greatly reduced and effective resistance is greatly increased while still maintaining a resistor of small physical size.

Like a cathode-follower, the emitter-follower has a low output impedance. Therefore, terminal 3 of Fig. 2A is close to ground potential. This fact allows the shield of the cartridge cable to be connected to terminal 3 which places the cable capacitance from the input to the output of the emitter-follower, thereby effectively lowering the cable capacity. With an emitter-follower gain of 0.99, a cable capacitance of 100 $\mu\mu$f. is reduced to a negligible value of 1 $\mu\mu$f. Of course, the cartridge output must still be applied between terminals 1 and 2, which requires a third lead to carry the ground. Preferably, this should be a second shield about the cable, but may be a separate unshielded wire, as shown in Fig. 2B.

Fig. 3 is the schematic diagram of the complete preamplifier. In order to prevent duplication of discussion, only the left channel circuit will be covered. What is said will, of course, apply to both channels.

CARTRIDGE	L_C (mhy.)	C_C ($\mu\mu$f.)	R_C (ohms)	3 db Point Low-Pass (kc.)	Resonant Peak* (kc.)	Preamp Output (volts)	Booster Output (volts)
Electro-Sonic C-100	1	Unmeas.	40	9000	2000	.039	.250
Fairchild XP-4	3	Unmeas.	600	3000	1500	.120	.756
Fairchild 232	4	Unmeas.	600	2000	1000	.120	.756
General Electric GC-5	500	50	600	18	30	.240	Note 1
Grado Magnetic	1	Unmeas.	600	9000	2000	.078	.491
Pickering 371		Note 2		Not Calculable		.390	Note 1
Scott 1000		Note 2		Not Calculable		.160	Note 1
Shure M3D	350	30	440	30	45	.200	Note 1
Stereotwin ST-200		Note 2		Not Calculable		.980	Note 1

*Resonant peak calculated includes effect of 500 $\mu\mu$f. cable capacity.
Note 1. Use of booster amplifier with these cartridges not recommended, in order to keep distortion level low.
Note 2. This data not available for these cartridges.

Table 1. Measured characteristics of some typical magnetic stereo cartridges along with their outputs when employing the circuits described in the text.

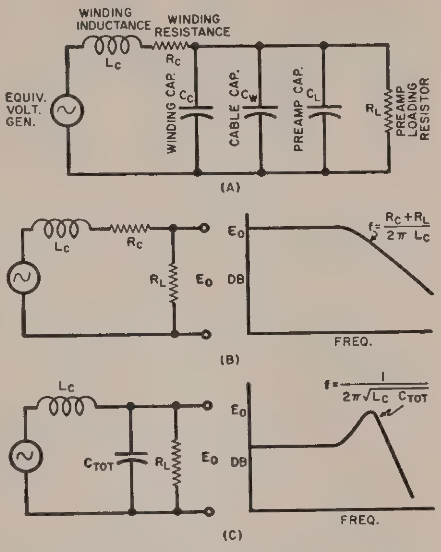
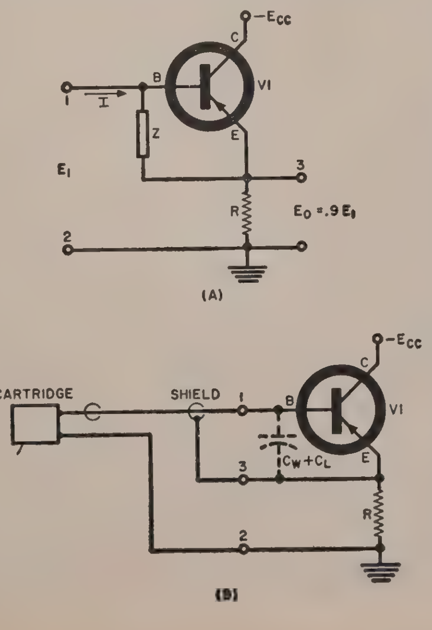


Fig. 1. (A) Cartridge, cable, and preamp equivalent circuit. (B) Equivalent circuit below cartridge resonance. (C) Equivalent circuit at cartridge resonant frequency.

Fig. 2. (A) Emitter-follower used as impedance multiplier. (B) Emitter-follower effectively lowers cable, preamp capacitance.



Note that input transistor V_1 is connected as a conventional common-emitter amplifier and not as an emitter-follower as previously discussed. However, as will be seen, the voltage across unbypassed resistor R_5 is actually a large fraction of the input voltage as previously detailed for an emitter-follower. Transistor V_1 has a common-emitter gain of about 20 db which means that ten times the input voltage appears across the 30,000-ohm collector load resistor, R_3. Since the same a.c. current flows through the 1000-ohm emitter resistor R_5, the voltage across this resistor must to 1/30th the voltage across the collector resistor (1000/30,000) or ⅓rd the input voltage appears across R_5. This leads to an impedance multiplication of 1.5—surely not a spectacular amount.

Feedback accomplishes the remaining impedance multiplication. The feedback network, C_4-R_6-C_8, from the collector of V_2 to the emitter of V_1 serves two purposes. First, it applies RIAA equalization to the preamplifier. Second, it feeds back sufficient output signal to R_5 in the proper phase such that the voltage across R_5 is approximately equal to the input signal. As a result, the impedance multiplication factor is about 80, surely adequate to minimize capacitance and allow the use of a physically small loading resistor for minimum thermal noise. The loading resistance is formed by the parallel combination of R_1 and R_2 (about 18,000 ohms), which establishes bias for V_1.

At low frequencies, the reactance of feedback capacitor C_4 is large. Therefore, at low frequencies negative feedback is small and the impedance multiplication factor is correspondingly small and approaches 1.5. Fortunately, a high value loading resistance is needed only at high frequencies where the low-pass filter effect comes into play. Actually, a lower impedance at lower frequencies is advantageous since the preamplifier offers a lower input impedance to stray hum fields and minimizes their pickup.

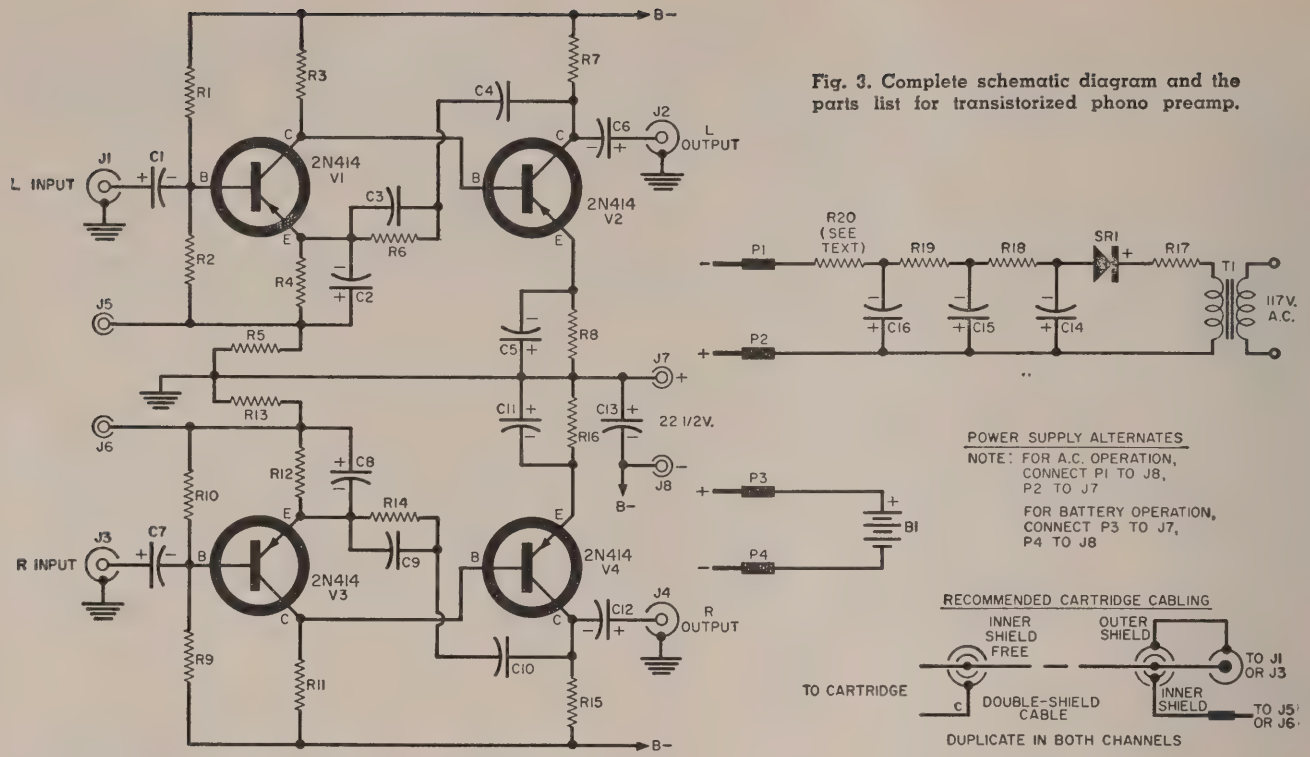

B−
R1
R3
R7
C4
C6
J2
L OUTPUT
J1
C1
L INPUT
2N414
V1
2N414
V2
C3
R6
R2
R4
C2
J5
R5
C5
R8
J7
C11
C13
22 1/2V.
R13
R16
J6
J8
R12
C8
R10
R14
B−
J3
C7
R INPUT
C9
2N414
V4
2N414
V3
C12
J4
R OUTPUT
R9
R11
C10
R15
B−
R20 (SEE TEXT)
R19
R18
SR1
R17
T1
117V. A.C.
P1
P2
C16
C15
C14
P3
P4
B1
POWER SUPPLY ALTERNATES
NOTE: FOR A.C. OPERATION, CONNECT P1 TO J8, P2 TO J7
FOR BATTERY OPERATION, CONNECT P3 TO J7, P4 TO J8
RECOMMENDED CARTRIDGE CABLING
INNER SHIELD FREE
OUTER SHIELD
TO J1 OR J3
TO CARTRIDGE
DOUBLE-SHIELD CABLE
INNER SHIELD
TO J5 OR J6
DUPLICATE IN BOTH CHANNELS

Fig. 3. Complete schematic diagram and the parts list for transistorized phono preamp.

R_1, R_9—240,000 ohm, low-noise deposited carbon res. (see text)
R_2, R_{10}—24,000 ohm, low-noise deposited carbon res. (see text)
R_3, R_{11}—30,000 ohm, low-noise deposited carbon res.
R_4, R_{12}—3900 ohm, ½ w. res.
R_5, R_{13}—1000 ohm, ½ w. res.
R_6, R_{14}—30,000 ohm, ½ w. res.
R_7, R_{15}—15,000 ohm, 1 w. res.
R_8, R_{16}—18,000 ohm, ½ w. res.
R_{17}—30 ohm, ½ w. res.
R_{18}, R_{19}—27,000 ohm, ½ w. res.
R_{20}—See text
C_1, C_7—8 µf., 30 v. elec. capacitor
C_2, C_5, C_6, C_8, C_{11}, C_{12}, C_{13}—40 µf., 30 v. elec.
C_3, C_9—2700 µµf., 500 v. mica capacitor
C_4, C_{10}—6800 µµf., 500 v. mica capacitor
C_{14}—12 µf., 250 v. elec. capacitor
C_{15},C_{16}—20 µf., 150 v. elec. capacitor
J_1, J_2, J_3, J_4—RCA phono jack
J_5, J_6, J_7, J_8—Pin jack
P_1, P_2, P_3, P_4—Pin plug
SR_1—Selenium rectifier, 20 ma., 150 v. (Federal 1159 or equiv.)
T_1—Isolation trans., 117 v. sec., 35 va. (Triad N51X or equiv.)
B_1—22½-volt battery
V_1, V_2, V_3, V_4—"p-n-p" transistor (Raytheon Type 2N414)

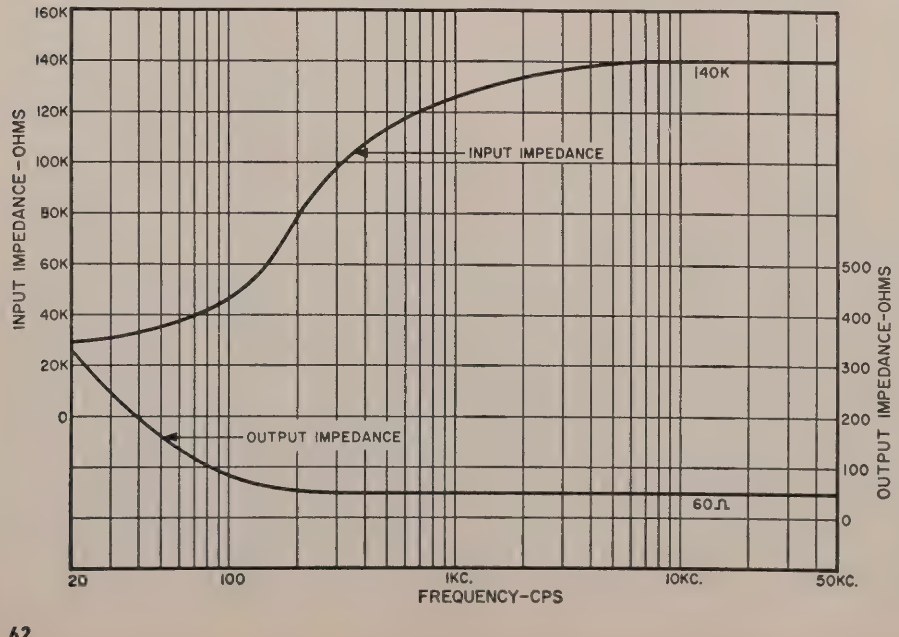
Fig. 4 shows the actual measured variation of input impedance with frequency. At low frequencies the input impedance is 27,000 ohms which is 1.5 times 18,000 ohms, the parallel combination of R_1 and R_2. At high frequencies the input impedance is 140,000 ohms, which represents a multiplication of 80.

Fig. 4 also illustrates another important virtue of the equalization feedback circuit; that of lowering the output impedance of the preamplifier. At high frequencies the preamplifier's output impedance is a low 60 ohms which allows the use of a longer length of shielded cable to the main power amplifiers without any attenuation of highs.

The preamplifier uses two direct-coupled common-emitter stages because this configuration is least sensitive to bias changes which may be caused by variations in transistor parameters or temperature. The d.c. feedback in the form of bypassed emitter resistors (R_4 and R_8) also stabilizes the preamplifier against transistor changes. The resulting basic preamplifier is very stable and has extremely wide response. As a matter of fact, without feedback equalization, the 1 db-down points of the preamplifier occur at 9 and 340,000 cps. This fact guarantees absolute minimum preamplifier phase shift within the audio band. Unless both preamplifiers have negligible phase shift in the audio band a phase error will exist between channels and cause a severe loss of stereophonic effect. The inherent stability of the preamplifier is indicated by the fact that the gain varies less than one decibel from zero to 85 degrees centigrade.

Raytheon Type 2N414 transistors were chosen because of their wide response, low noise, and low cost (only $2 each). The entire preamplifier can be built for less than $25 complete. In order to keep the price as low as this without sacrificing performance, the gain of the preamp is average, which means that the gain is adequate for medium- and high-output magnetic cartridges, but insufficient for low-output cartridges. If low-output cartridges are to be used, the gain will have to be increased by the addition of a booster transistor amplifier following the main preamplifier. Fig. 7 is a sche-

Fig. 4. Curves showing the variations in the input and output impedances of unit. Note how the input Z rises and the output Z falls as the frequency is increased.



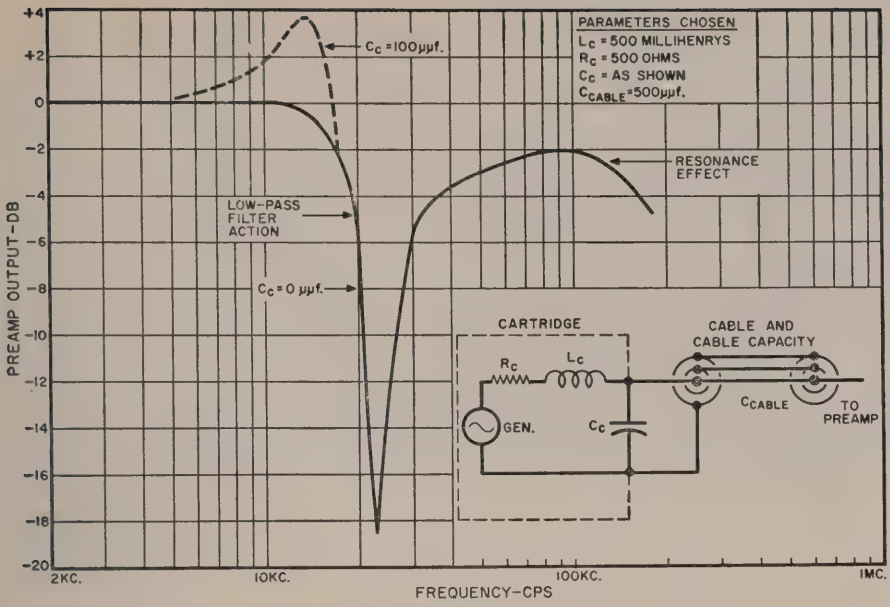


Fig. 5. Curve showing the measured high-frequency effects described in the text.

matic of an appropriate booster amplifier for low-output cartridges. Clearly, it is an expensive waste to build in gain to handle all cartridges if a medium- or high-output cartridge is to be used.

Table 1 shows what outputs can be expected from typical stereo cartridges which were checked with the preamplifier—both with and without the booster. Table 1 also indicates which cartridges should not use the booster amplifier. Medium- and high-output cartridges should not use the booster because the high levels will cause unnecessary distortion in the booster amplifier and the output level from the preamplifier is adequate.

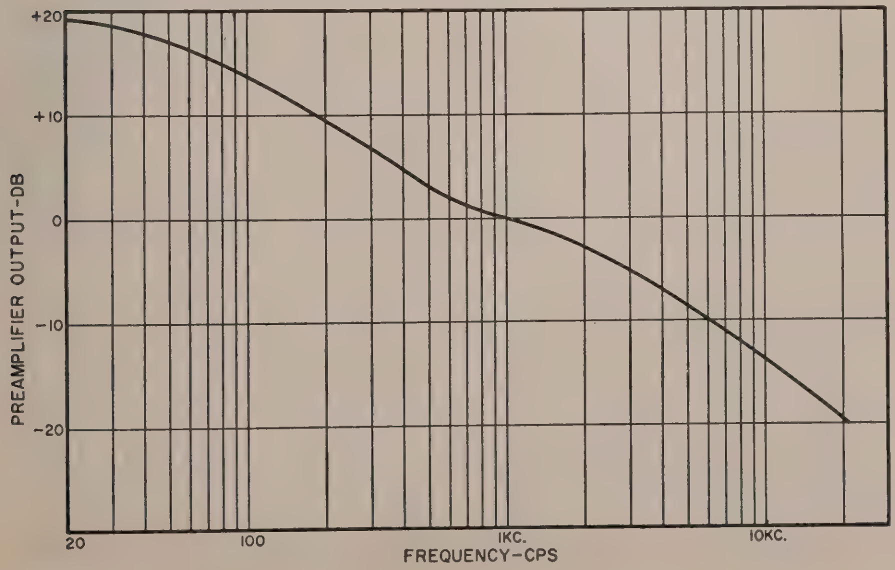
As a further means of reducing cost, tone and volume controls were not incorporated. Actually, such controls do not belong on the preamplifier proper, but rather on the main amplifier or control center. The principal task of the preamplifier is to draw maximum stereo performance from the cartridge and to accurately apply RIAA playback equalization. This the transistor preamp does, and does excellently.

Performance

In order to evaluate the performance of the preamplifier, several tests were run. First, feedback capacitor C_4 was shunted with a large value capacitor (40 μf.) and capacitor C_3 removed. This applies a constant amount of feedback across the audio band and allows analysis on a flat-response basis rather than having to take the RIAA characteristics into account. Such an approach is valid since the RIAA characteristic merely superimposes its own curve on the flat response of the preamplifier. With the preamplifier thus modified, it is flat to 340,000 cps and allows the investigation of high frequency low-pass and resonance cartridge effects.

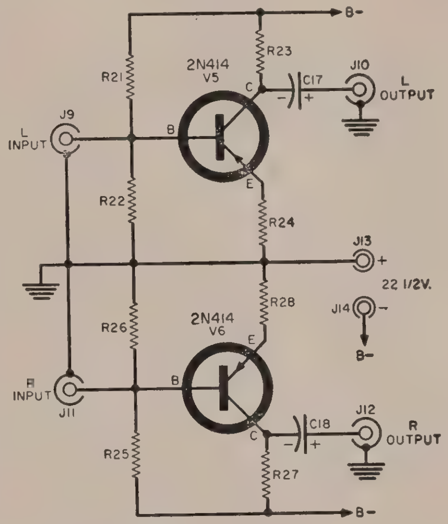
Fig. 5 shows the test setup used. A cartridge equivalent was constructed as shown and connected to the preamplifier using a 500 μμf. cable—then the preamplifier's response was measured.

Fig. 6. Here is the actual measured RIAA playback characteristics of the preamp.



Low-pass filter and resonance effects will be most severe with large cartridge inductances (L_c). Of all the cartridges checked, the *General Electric* Model GC-5 had the highest inductance —500 mhy.—so this value was used. The GC-5 has a coil capacitance (C_c) of 50 μμf. which places the cartridge resonance at 30,000 cps. In order to make the problem more severe, 100 μμf. was used which places the resonant peak at 13,500 cps. Note that even with this severe capacitance the response is reasonably flat to 17,000 cps, rising only 3.7 db at resonance. With the actual value of 50 μμf., resonance effects lie completely outside the audio band.

Removing C_c allows evaluation of low-pass filter effects. For the GC-5 inductance of 500 mhy., the preamplifier causes a low-pass 3 db point at 18,000 cps. The resonance shown in Fig. 5 at 95,000 cps is due to cable capacitance reduced in value from 500 μμf. to approximately 5 μμf. by the preamplifier.



R_{21}, R_{25}—180,000 ohm, ½ w. res.
R_{22}, R_{26}—13,000 ohm, ½ w. res.
R_{23}, R_{27}—15,000 ohm, ½ w. res.
R_{24}, R_{28}—2000 ohm, ½ w. res.
C_{17}, C_{18}—40 μf., 30 v. elec. capacitor
J_9, J_{10}, J_{11}, J_{12}—RCA phono jack
J_{13}, J_{14}—Pin jack
V_5, V_6—"p-n-p" transistor (Raytheon 2N414)

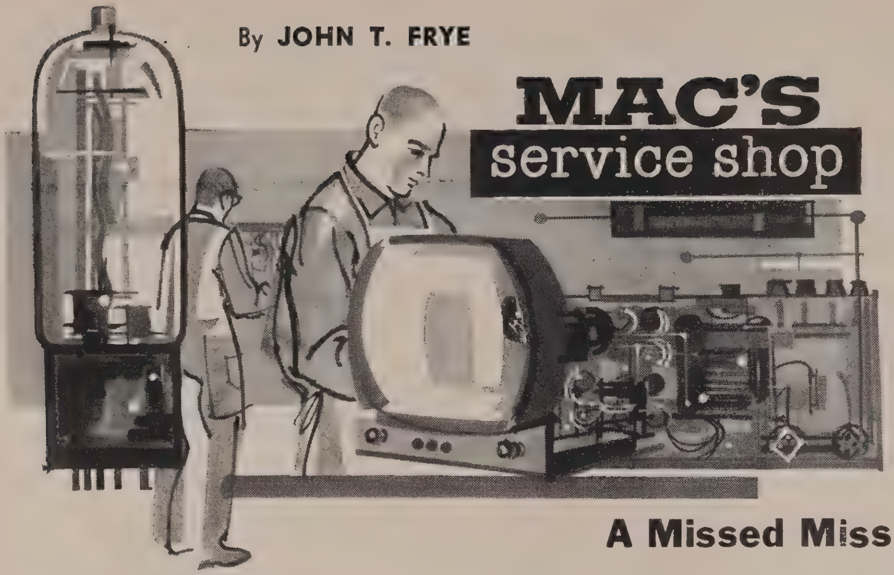
Fig. 7. Schematic of booster amplifier.

The GC-5 represents the most severe case of high-frequency effects due to its high inductance. Table 1 indicates the location of the 3 db low-pass filter point and resonant peak for several other popular cartridges, measured in the same manner as for the GC-5. All cartridges listed are unaffected by the preamplifier and response is limited *only* by the response of the *cartridge* itself. If the GC-5 is to be used, its low-pass 3 db point should be raised to 36,000 cps by increasing R_1 and R_9 to 470,000 ohms and R_2 and R_{10} to 47,000 ohms. This increases the noise level slightly, but this is compensated by the higher output of the GC-5. As a result, the signal-to-noise ratio remains the same as for lower output cartridges.

(Continued on page 96)

By **JOHN T. FRYE**

MAC'S service shop



A Missed Miss

IT was Monday morning, and Miss Matilda Perkins, "office force" of Mac's Service Shop, was returning to work after a two-week Florida vacation. It was no accident she looked particularly attractive. The occasion somehow seemed special, and she had dressed for it. According to Matilda's standards, her aqua-colored summer sheath dress was cut daringly low in the back to show off her beautiful tan. After all, that tan had cost an estimated one-hundred dollars a square foot; and it made no sense to hide it! She smiled happily to herself as she anticipated the appreciative wolf-whistle with which Barney, Mac's assistant, would undoubtedly greet her.

But when she stepped into the office portion of the service shop it was deserted. Her face fell a little as she walked across to her familiar desk and absent-mindedly rubbed a finger of her white nylon glove over the surface and then looked at it: not a trace of dust. The desk was spotless and in perfect order. What's more, the whole office was simply shining.

Matilda felt strangely disappointed. All the while she had been driving her car through the red fields of Georgia, up and down the beautiful rolling hills of Alabama and Tennessee, and then along the Kentucky Turnpike, she had pictured herself, after that stunning entrance, as peeling off those white gloves, slipping into her smock, and happily tearing into the dust and disorder she was certain would be present after her two-week absence.

"Guess they didn't miss me because they don't need me," she said sadly to herself as she walked toward the closed door of the service department.

As she pushed the door inward, the room was in complete darkness and apparently deserted; but before she found the light switch, she was grabbed and soundly hugged by at least two people while the familiar voices of Mac and Barney were shouting in opposite ears, "Welcome home, Matilda! Welcome home."

The lights came on, and at the same time the plaintive notes of her favorite recording "September Song" began issuing from a repaired hi-fi console in the corner. A white tablecloth was spread over an improvised table in the center of the room and a vase of beautiful red roses adorned it. Also on the table were three huge frosty-looking chocolate sodas and a heaping dish of vanilla wafers—two of Matilda's gustatory weaknesses.

"Wheee-whooo!" Barney whistled as he spun her around and took in the well-fitted dress and the tan; "don't we look scrumptious!! Let's see how far that tan extends, Tildy," he teased as he pretended to reach for the zipper on the back of her dress.

"Down, *Lobito!*" Matilda retorted as she slapped away his hand. She walked over and read aloud the card nestled among the roses: "Don't leave us again, Matilda. We love you. Mac and Barney." Blindly she got a handkerchief out of her brand-new alligator-skin bag and dabbed at her eyes. "You big lugs ought to be ashamed of yourselves for making a girl cry," she said as she managed a rather wobbly smile.

Soon they were enjoying the sodas and all three talking at once.

"You boys certainly kept the office clean," she complimented.

"Oh *that!*" Mac said disparagingly. "Don't let it fool you. My wife had Barney and me slaving away until after midnight Saturday cleaning up the joint. You should have seen it when we started. My wife said she wasn't going to have you come back from a lovely vacation to such a pig-sty as this was. She nearly worked us to death didn't she, Barney?"

"Did she ever! Geeee! What a top-sergeant Mrs. McGregor would make! I just never realized before, Matilda, how you have to be continually after a place like this to keep it from going to seed. And if that office looked bad, you should have seen this part. You could hardly walk through it. Mac and I both know now how important your continual nagging at us to keep the shop clean and in order really is. You don't know how we missed hearing you say: 'You can't make a call in that soiled uniform; go change it.' 'That bench looks ready to start. Why don't you redd it up and start over?' 'I'll bet if these windows were washed a person could see it was a nice day outside.' "

"Neither did we realize what a load you took off us by wrestling with the customers on the phone or in person," Mac interrupted. "It seemed that when I reached the critical point in a dial-stringing or alignment job invariably the telephone would ring or the front door would open and I would have to drop everything and go talk to the customer. He or she always went into a long and involved discussion of the set's case history from the day he bought it right down to now. I've heard you listen to these stories with every indication of sympathetic interest time after time; and I'm thoroughly convinced you deserve a medal for patience, tact, diplomacy, and histrionic ability."

"And keeping the files straight, the books up to date, and the parts stock in order is a full-time job by itself," Barney added. "Mac and I did our best, but I'm afraid you'll find things a little messed up in those departments."

"Mostly, though, we just missed *you,*" Mac said gruffly. "That front office seemed as empty and lifeless as a TV cabinet with the chassis pulled. We're mighty glad to have our office girl back, and we're convinced no service shop should try to operate without a reasonable facsimile of same. But enough of this. Did you have a good time on your vacation?"

"A wonderful time," Miss Perkins answered. "As you know, Sylvia Richards went with me, and this was her first trip to Florida. It was my fourth trip, and playing guide is always lots of fun. We went down the west coast, taking in St. Pete, that beautiful Sunshine Skyway Bridge, and the other cities along the Gulf. Then we crossed the Tamiami Trail and went down the Overseas Highway to Key West. We spent one night on Greyhound Key with the ocean on one side and the Gulf of Mexico on the other and with the wind and the surf singing a lullaby all night long. Golly, how I slept there!

"Then we came up through Miami and took Highway One all the way to Cocoa, where we turned inland to Orlando. We stayed with an uncle and aunt there for about a week. My cousin, Donald, is a great fisherman; and he had Sylvia and me seining bait and catching flounders and triple-tail in Cape Canaveral Harbor every minute we were not sightseeing with my uncle and aunt.

"What a romantic fishing place that is! On one side of the harbor you can see submarines and other government ships tied up in the shadow of a huge crane that could, I'm convinced, pick up a locomotive as easily as I pick up a potato chip. Across the harbor a great ocean tanker is tied up at the dock of a citrus-fruit plant while its refrigerated hold is pumped full of or-

(*Continued on page* 110)

Safeguard Your Shop

By **ERNEST W. FAIR**

Is your service business one of the many that is not adequately protected against damaging losses?

"WE HAVE good locks, a burglar alarm, and plenty of insurance—so why should we worry?"

That is a frequent response when a service-shop operator is asked whether he has done everything he can to safeguard himself against such hazards as burglary and fire. Each of the items mentioned is indeed necessary in a plan for adequate protection of a radio-TV shop while the owner is gone overnight or over a holiday—but by themselves they do not provide the full protection required. Too many shop owners have relied on these measures exclusively, to their later regret. Complete protection involves consideration of many things, some of them insignificant in themselves, yet important in the over-all scheme. A number of these items are considered here. The service dealer will find it useful to check his own practice against each point mentioned to judge for himself just how thorough his own protective measures are.

Don't be careless about money. Customers and other people notice such things and talk. No one, not even employees, should know where shop money is kept *if* it is placed anywhere other than in a recognized, protective device. It's never good policy to take all the cash home every night. It's also poor procedure to have "secret" hiding places on the shop premises. If it is inconvenient to use a bank's night depository, protection provided within the shop should be of the right kind.

The right kind of protection, of course, is a safe. This doesn't mean that a big investment must be made; there are a number of good ones of small size. One of these can be quite adequate when put in the right place and installed in the correct manner. The "right place" requires a little thought. It is not a dark corner where no one is likely to see the safe. On the contrary, it should be where it can be seen from the street at night. A light shining over it will help.

If the safe has rollers on it, removing these is a good idea. There's no sense in making it easy for a burglar to take the safe with him and worry about getting out the contents at his leisure. For maximum safety, especially if the safe is one of the smaller, lighter ones, it should be set in a small bed of concrete.

The cash register should be made as conspicuous as the safe. That is, it should be clearly visible from the outside at night and should also be well lighted.

The simple factor of light itself affords considerable protection. Even where no safe or cash register is involved, it is always a good idea to keep at least one fairly bright light burning in the shop all night. The actual cost on the utility bill will amount to only a dollar or so a month, which is a reasonable price for the service rendered. Be sure to use bulbs of good quality in such fixtures. Remember, you are not only depending heavily on their reliability, but they also must burn for a goodly number of consecutive hours.

To supplement interior lighting, an investment in mirrors is definitely worthwhile. A few of them well-placed in the back of a lighted shop will make it virtually impossible for someone to hide behind equipment or fixtures, out of direct range of vision.

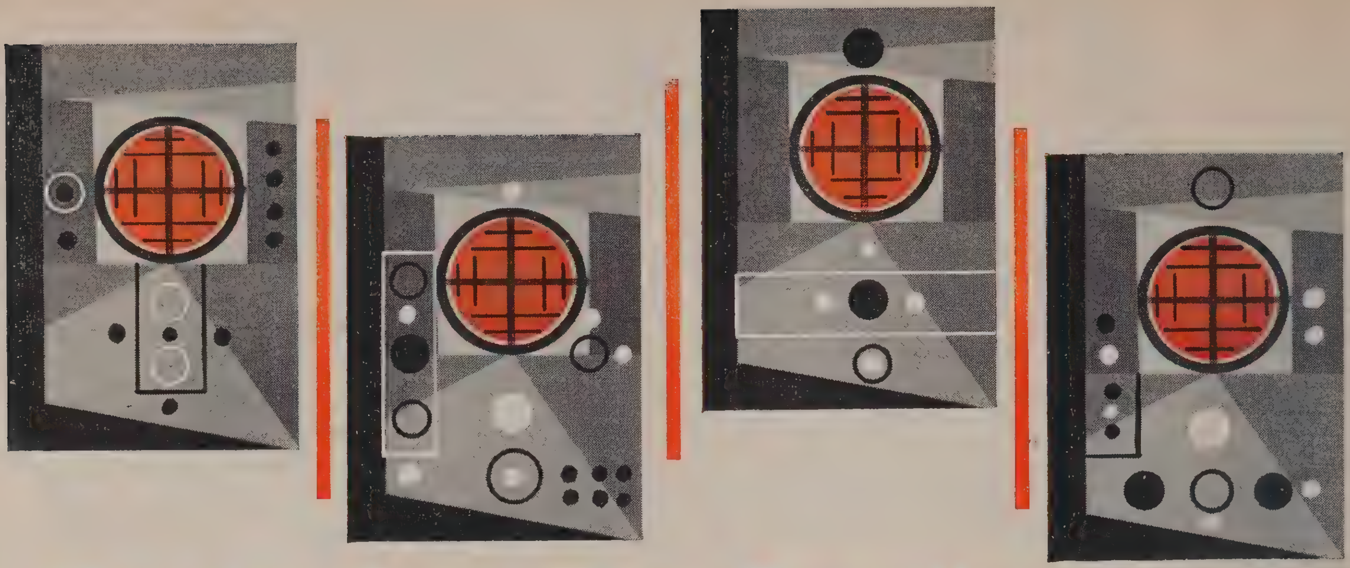
Before we leave the subject of illumination, here are some other suggestions. Make certain that there are lights over the back door to the shop and any other means of access, especially those that are in otherwise darkened areas. These extra lights are always a good investment in terms of the small cost involved. Prowlers and vandals just won't work under lights if they can possibly avoid them. As long as there are other available places that are less well protected they can victimize, they will "take their business" to these other "customers" if you carefully avoid cooperating in their schemes to "patronize" you.

Of course, thieves can always manage to break or put out light bulbs. However, this creates another hazard for them, of which they are well aware: There is always the possibility that your lighting plans are known to the police—as they should be—and that the absence of a light that should be on will attract as much attention as the light itself. Don't let this possibility be a mere bluff. Get acquainted with the police in the prowl car that patrols your street at night. Let the police know exactly what your lighting plans are—where each light is located—and let them know that you will definitely keep these lights on regularly. If you are faithful in sticking to your lighting plan, the disabling of any light will provide an automatic indicator to the law that something is wrong.

It is surprising how many burglaries of small business firms occur because the owner or an employee *did not* lock a door before leaving. This could happen to any of us and it is most likely to occur when one is in a rush to leave. Make it a strict rule to check every lock, light, or other safeguard one extra time before leaving—especially when you're in a hurry. If a gnawing doubt arises concerning whether you actually did take care of any of these items, after you have left, go back. The one time that this doubt might turn out to be correct will more than repay you for your extra trouble.

In addition to locks on doors, iron bars are worth using. One that can be put in place across the back door at night is an excellent deterrent. Metal bars across windows, skylights, and door glass for all doors except the

(*Continued on page* 120)



Evaluating An Oscilloscope

By **DAVID R. ANDERSON**

To buy a new scope or get the most out of one you have, you must interpret specs in terms of use.

EDITOR'S NOTE: *Oscilloscope manufacturers are seldom reluctant to publish specifications these days. Whether you are buying, already own one, or are wondering about the need for a replacement, the problem is that of interpreting abstract specs in terms of concrete performance. You may ask such questions as: "Will the instrument serve for all the applications I intend?" "If it falls short, do I need another one or can I adapt it to my needs without much trouble?" "Can I manage by simply taking limitations into account in interpreting the data it provides?" In the long run, you must develop your own answers, but the information here will help.*

IF you are in the market for a new oscilloscope, you want to purchase one that will be adequate to your purpose with minimum expense. If you already own one, you want to get the most out of it and also find out where and when not to use it. In either case, your point of departure is a list of the instrument's specifications.

A typical list of important specifications appears in Table 1. While the particular values given would be for a good instrument intended, say, for a service bench, they are not to be taken as absolute standards. Depending on the work in which the scope will be used, there will be considerable latitude for many specifications. Also, the values chosen for illustration do not apply to any particular instrument.

The first two items on our list concern the cathode-ray tube and the voltage applied to its second anode. The voltage has direct bearing on the resolution and intensity of the trace. If the second-anode voltage is too low when compared to the maximum recommended or typical operating voltage for the CRT, as listed in the tube manufacturer's manual, sharpness and brightness of the trace will be reduced.

For example, the maximum rated voltage for the 5UP1 is generally given as about 2500 volts, with 2000 volts listed as typical. Suppose that a scope using this tube operates with 1400 volts or less on the second anode. Since this reduced potential makes the electron beam less stiff, gain requirements in the vertical, horizontal, and blanking amplifiers are also thereby reduced. As a result, the accumulated differences make it possible to manufacture and sell a scope at less cost than if a higher second-anode voltage were used. In this connection, note that manufacturers of the 5UP1 do not recommend its use with less than 1000 volts.

Table 1. The type of information to look for in manufacturers' specifications.

CATHODE-RAY TUBE	
Type	5UP1
Accelerating Potential	2100 volts on 2nd anode with respect to cathode
VERTICAL AMPLIFIER	
Sensitivity	25 r.m.s. millivolts/inch
Frequency Response	Flat 15 cps to 4.5 mc. ± 3 db
Rise Time	.06 microsecond
Overshoot	2% over usable range
Input Impedance	3 megohms shunted by 50 $\mu\mu$f.
Attenuator	4-position, frequency compensated: X1, X10, X100, X1000
Gain Control	Direct reading; calibrated for peak-to-peak reading
HORIZONTAL AMPLIFIER	
Sensitivity	0.6 r.m.s. volt/inch
Frequency Response	Flat 10 to 500,000 cps ± 3 db
Sweep-Generator Range	From 10 to 500,000 cps in overlapping ranges
Retrace Blanking	Complete on all ranges
Sync	Internal positive or negative; external connection; or line frequency (60 cycles)

If this voltage does not seem very high in an otherwise acceptable instrument you are evaluating, it may still be adequate, depending on how much brightness and resolution you require. If you have any intentions of photographing oscillograms, for example, you would place increased value on this characteristic. Sometimes a scope with low second-anode voltage will have a tinted, acetate filter mounted over the face of the CRT. Since this blocks outside light from the face of the tube, apparent intensity and resolution are improved.

Concerning the vertical amplifier, we deal with its sensitivity first. This is usually stated in terms of the minimum necessary input voltage, at full gain, to provide a given amount of deflection (vertical) on the face of the tube. If 25 r.m.s. millivolts, or .025 volt, applied to the input of the vertical amplifier produce one inch of deflection, the sensitivity may be rated as 25 r.m.s. millivolts/in. In general, a scope with this sensitivity is adequate for TV servicing. If a lower voltage is given as producing one inch of deflection, this means the instrument is still more sensitive. Note that extreme sensitivity can also be undesirable, as it may increase the possibility of picking up stray fields that can dis-

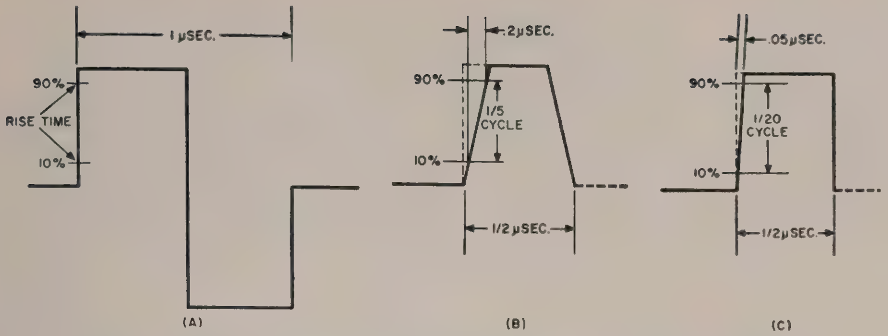


Fig. 1. A square wave (A) or any high-frequency waveform will be distorted considerably (B) by slow rise time, but only slightly (C) by short rise time.

tort the waveshape under observation. In some cases, this figure is given in centimeters rather than inches, but conversion to inches can be made easily. (2.54 cm. = 1 in.)

The vertical amplifier's frequency response is also important. An ideal unit would amplify all frequencies within its range equally well, providing a perfectly flat response curve. However, this idealized and impractical response is not necessary—as long as the frequency discrimination is taken into account by the user when examining waveforms. Most listings use the db method of rating this characteristic. To avoid confusion, some understanding is necessary here.

For instance, take the response specification given in Table 1. This appears to be exceptionally flat, because we know that a 3-db change in *sound* level is barely detectable by the human ear. However, this same change in the gain of a vertical amplifier is equal to a visual (voltage) variation in the height of the trace of 30 to 40 percent. In other words, ± 3 db means that a "flat" response curve could vary 40 per-cent above and 30 per-cent below amplitude of the reference frequency used. Fig. 2 indicates the relationship between db and percentage of variation. Frequency response that is acceptably flat to the eye would not vary more than ±1 db, a variation of +12 per-cent to −10 per-cent.

Fortunately, maximum deviation from flat response usually occurs at the extremes of the range. Many manufacturers also show, in addition to the ±3 db rating, the range over which response will vary less (for example, ±1 db from 20 cps to 3.5 mc.). In any case, foreknowledge of the nature of frequency amplitude discrimination will help you take it into consideration when viewing certain waveforms.

The rise time of the scope is the minimum time it takes the beam to go from 10 per-cent to 90 per-cent of the maximum deflection of the phenomenon being viewed. Rise time becomes important if high-frequency waveforms or those with steep wavefronts are to be observed.

If a 1-mc. signal, particularly a square wave, as in Fig. 1A, is being viewed, it takes one microsecond to complete one cycle. If rise time is .2 microsecond, one-fifth of the cycle will have passed before the beam can reach 90 per-cent of maximum deflection. This will cause the leading edge of the trace to slope as shown in Fig. 1B, considerably changing the appearance of the waveform.

Now suppose that, under the same conditions, rise time is .05 microsecond. Then only one-twentieth of the cycle will have passed before the beam reaches 90 per-cent of maximum deflection. This will allow the leading edge of the trace to be much steeper, as shown in Fig. 1C, than with the slower rise time. A rise time of .05 microsecond is more than adequate for TV service work.

An example of overshoot is shown in Fig. 3. The spikes on the leading edge of the square wave are caused by excessive high-frequency compensation in the vertical amplifier. If overshoot is too great a percentage of the total amplitude of the waveshape under observation, it will cause distortion. The percentage of overshoot is found by taking ½ normal peak-to-peak value of the waveform and determining what percentage of this value the spike comprises. The percentage of overshoot in a well designed scope will be 2 per-cent or less.

When a scope is connected across a circuit, its input resistance and shunt capacity are in parallel with the circuit under test, as shown in Fig. 4. The higher the input resistance of the scope, the less current it will draw and the less it will load the circuit under test. Also the smaller the input capacity, the higher will be its reactance and the less it will distort the input signal. In some cases it is necessary or helpful to use a low-capacity probe which effectively reduces the input capacity of the scope. This is especially true at the higher frequencies where the shunt capacity will have the greatest effect. If the scope has an input resistance of one megohm or more shunted by 50 μμf. or less, it is suitable for connection to most points in a TV set.

The vertical-attenuator switch does exactly what its name implies. It attenuates the signal applied to the input of the vertical amplifier thus preventing overload and consequent distortion on high-amplitude signals. It is necessary that the vertical attenuator have some sort of frequency compensation if its impedance is to remain constant at all frequencies.

The vertical attenuator usually operates in steps of ten, with the first step a one-to-one ratio. If the highest step is one-hundred-to-one and the scope can handle a 2-volt peak-to-peak signal with no attenuation then, in the X100 position, it can handle a peak-to-peak input of 200 volts.

The continuously variable vertical gain control simply varies the gain of the vertical amplifier, as a rule. It may or may not be directly calibrated. If the gain control is directly calibrated, the peak-to-peak voltage of the waveshape under test is found by multiplying the number of spaces it covers on the screen of the CRT, times the setting of the gain control, times the setting of the vertical attenuator.

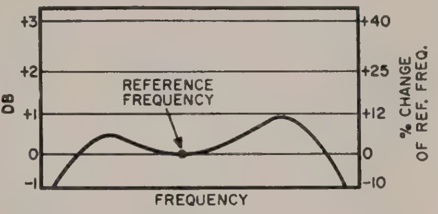


Fig. 2. A response curve, "flat" to the ear, within ± 1 db. The same variation as seen on a scope will seem less flat.

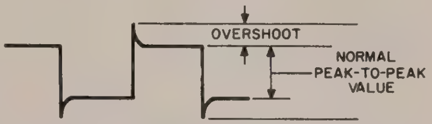


Fig. 3. Overshoot results from excessive h.f. peaking, distorts waveform.

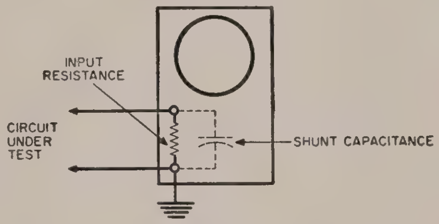


Fig. 4. Scope loads h.f. circuits with input capacitance as well as resistance.

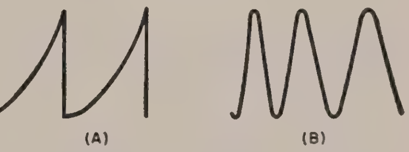


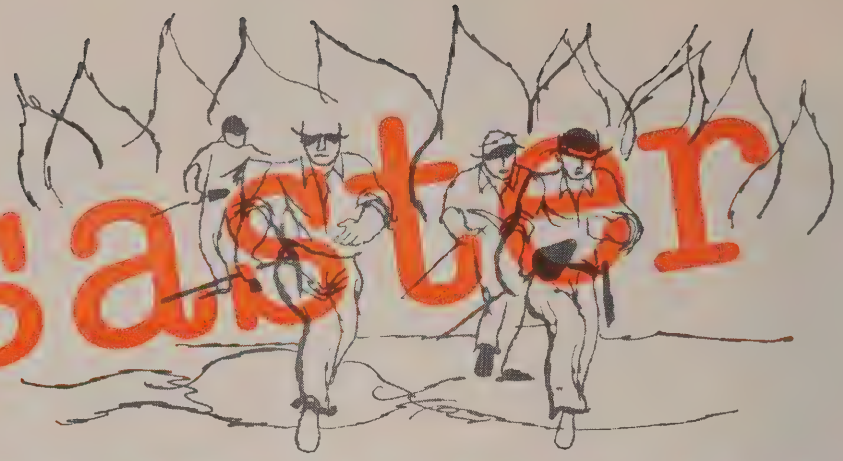
Fig. 5. Nonlinear saw-tooth output (A) from scope's horizontal amplifier will distort total trace (B) seen on screen.

The sensitivity and frequency response of the horizontal amplifier need not be as good as that of the vertical amplifier. Since the horizontal amplifier is usually connected to an output of the sweep generator, and this output is quite large, a sensitivity of .6 r.m.s. volt/inch is adequate.

There is virtually no occasion in TV service work that requires feeding a complex signal into the horizontal am-

(*Continued on page* 96)

Disaster



Ham Disaster Communications in Los Angeles County

By **HOWARD SHEPERD**

A description of a unique Radio Amateur Civil Emergency Service now operating in California.

IN RECOGNITION of the unique ability of licensed radio amateurs to provide invaluable facilities and experience in times of local or national emergency, the Federal Communications Commission adopted Sub-Part "B" to the Amateur Service Rules and Regulations in November, 1953. Provision was made therein for authorizing special licenses to amateur stations and operators under local government Civil Defense and Disaster organizations.

The Board of Supervisors of Los Angeles County had, at that time, already established a Disaster Authority by ordinance, under which the Sheriff of Los Angeles County was given the responsibility for emergency communications. With the approval of the California State Office of Civil Defense and the Federal Civil Defense Administration, a radio plan, prepared jointly by interested amateur operators and the Sheriff's communications experts, was presented to the FCC and the station license K6CPT was issued to the County RACES group.

Because Los Angeles County embraces over 4000 square miles of varied topography, which includes beach, mountain, and desert terrains as well as thickly populated urban areas, the RACES group faced a formidable task. Initially, the County was divided into 14 geographical districts and a county-equipped RACES station was established in each district—usually at a Sheriff's sub-station.

Local amateurs in each district volunteered their services and were assigned sub-calls of K6CPT which identified both their district and privately owned equipment. All of the RACES calls are used only in accordance with Section 12.254 of the FCC amateur rules and may not be employed during normal amateur contacts. The FCC rules further provide for "tactical" call signs to be assigned to facilitate control and procedure. This permitted the L. A. County RACES to identify special units and certain geographical areas to aid in recognition.

Sheriff Pitchess had anticipated the need for mobile communications centers for emergency use and, among other provisions, the department has a large custom-built truck equipped with a 300-watt transmitter capable of contacting radio cars, the fire, forestry, and other commercial radio services. This van has it own integral gasoline-engine-driven alternators that provide 6000 watts of regulated 120-volt, 60-cycle a.c. (See "Radio Aids Rescue Operations," RADIO & TV NEWS, September 1958.)

Two RACES-equipped radio patrol vehicles carry a variety of gear to cover all bands and frequencies that may be involved in an emergency or disaster.

Early tests of the RACES nets were conducted in conjunction with the national "operation alerts" set up by the F.C.D.A., and in many local "command post exercises" developed by the L. A. County Disaster Authority office.

In recent years the RACES group has undertaken several specific training missions for mobile and portable units. "Operation Blacktop" and "Blacktop II" demonstrated that several hundred mobile units could be activated and moved in orderly, radio controlled fashion, to selected remote areas of the County in short periods of time. The distance covered by participating ham units in these two operations total approximately 2500 miles.

In the first test, more than a hundred units were activated and directed to a staging area near Newhall, California at the foot of the Ridge Route on U. S. Highway 99. The second test brought hundreds of ham vehicles together at a mile-high rendezvous point in the forests of the San Gabriel Mountains, which border the Los Angeles Basin to the north. These tests proved highly

Shown at their operating positions at the Center are the following volunteers: (left to right) Ed Jesser, Radio Operator; Archie Beauvais, Communications Officer; George Cohagen, Chief Radio Operator; Mary Rodriguez, Teletype Operator.

Here is a front-seat view of the Mobile Communications Unit, containing transmitters and receivers covering all the frequencies.

Jerry Kunz, 29, at his desk in the RACES installation. Jerry performs his valuable service completely on a voluntary basis. ▶

useful in that techniques polished during this exercise were tapped during the recent Malibu area fires.

During the Malibu fires, Sheriff Pitchess directed the large mobile communications van to a high point in the area from which it served as the central transmitting and receiving point for all communications during the disaster. The extreme variations of terrain in this area—deep gullies and higher mountain ranges—necessitated that mobile units be placed at vantage points to provide the required network. A link on 145.46 mc. was established to the sub-station at Malibu. This was supplemented by a network that tied in to the main County Disaster Command and Information Center at Biscailuz Center in East Los Angeles, a distance of approximately 45 miles. Frequencies of 1995 kc. in the 160-meter band; 3995 kc. in the 75-meter band; and several channels on 10, 6, and 2 meters, were utilized.

Working in shifts, the RACES group manned the circuits continuously for seven days. Often husband-wife RACES members took turns at the mike for days at a time in order to keep the message traffic moving. With more than 100 Sheriff's vehicles in the area and many more hundreds of fire and other disaster service vehicles on duty, the total message count reached an average of 1000 per day.

While mention has been made of those active in the fire area, it should be noted that hundreds of other RACES members and non-affiliated hams greatly aided the situation by standing by and monitoring all circuits to be ready to relay or assist the various N.C.S. if needed. Also, due to skip conditions, it was often necessary to contact amateurs across the U. S. asking their cooperation in ceasing operations on the frequencies then in use in the disaster region. Such cooperation was readily given so that the low-powered mobile and portable units were able to enjoy clear-channel operations.

To aid in disaster communication planning, coverage tests from selected locations are made continuously to minimize the necessity for experimentation under actual emergency conditions. "CPT 19" in Hollywood acts as net control station on 3995 kc. once each week and deploys a mobile "target" to the location to be tested. The "target," one of the RACES mobile units, transmits briefly to the listening members who are located throughout the County. "CPT 19" then gathers reception reports from the net members and, in turn, the "target" reports the manner in which he has been able to receive the net transmissions. The data thus obtained is then collated for future reference.

Shown below is the 150-foot main transmitting antenna with the Civil Defense and Disaster Communications antennas mounted on the tower itself or connected to it.

One of the County agencies most vitally interested in communications is the Fire Department. (See "Communications in Fire Control," July 1958 RADIO & TV NEWS.) To provide for smooth coordination of RACES with their operations, the Disaster Director's office arranged "Operation Firedog" in January of 1959. This three-hour test involved the activation of 100 mobile units in the Central and Southern area of the County, with the objective of establishing a secondary radio network paralleling the County Fire Department's dispatching circuit. The deployment of RACES mobiles to some 46 selected fire stations was rapid. Both simulated and actual fire dispatches were handled. RACES proved the value of its long experience and excellent facilities by actually delivering dispatches to the Fire Station Commanders in the field with as little as 10 seconds elapsed time from the moment the message was handed to the RACES operator at Fire Headquarters. The majority of all messages was delivered in less than 3 minutes, with the average being under one minute. The dispatch rate was approximately one per minute —so it can be seen that the system is capable of handling a very heavy message load.

While a major disaster is a frightening ordeal—whether involving fire, flood, earthquake, or other catastrophe —it is only prudent that all means to alleviate suffering and direct rescue efforts be kept in readiness. The RACES program provides an instantly available and extremely flexible facility for such use and must be given every opportunity to develop to its fullest in any jurisdiction. K6CPT intends to continue to expand and prepare ever more efficient and extensive emergency communications to Los Angeles County. —30—

appraising your BUSINESS POSITION

By **WILLIAM LEONARD**

Non-service competition, lack of fringe benefits, irregular income, hit the self-employed hardest.

THE MAJOR difference between working as an employee for someone else and functioning as an independent businessman operating on your own is the freedom the latter gives you to carve out your own economic future.

As an employee, you are reasonably sure of getting your pay checks at regular intervals. You gear your family life to your "take home" pay and hope that future raises will enable you to buy some of the conveniences you cannot afford today. Your job will provide a certain degree of security if you are sick or laid off from work. It is mandatory for your employer to pay Uncle Sam your FICA tax, sharing its cost equally with you. In most states, your employer must maintain certain insurance policies for your protection. In addition to these mandatory provisions, your job may provide such fringe benefits as annual vacations with pay and low-cost medical, surgical, and life insurance.

You may not be conscious of, nor concerned with, the fact that your employer had to make an investment of from five- to twenty-five thousand dollars to make your job possible. And it may not be of interest to you to know that he must be an astute businessman to realize six per-cent interest annually on the investment he has in you and your job. These are the things you are inclined to take for granted when you are an employee. But they are the things that can, and usually do, give you many sleepless nights when you are an employer with your own money tied up in a business.

Economic pressures and an unpredictable market are bringing about many drastic changes in electronic service businesses. Operating in a market that, over-all, has a subnormal ceiling on service charges, dealers with all sizes of businesses are finding it difficult to absorb the steadily rising costs of operating and the increases in day-to-day living expenses from an average volume of business that had formerly been reasonably adequate. Those who operate one-man shops, for example are hard-pressed for ways and means to increase the volume of business coming in and the time to take care of it to meet these rising costs.

Every full-time business, regardless of how small it may be, automatically has an overhead load that must be paid out of the business income. A service operator may use a part of his home for his shop and thus save the cost of renting a business location, although this is not always possible. He may use residential phone service instead of the conventional business type, and effect some questionable savings in telephone and directory-listing charges. But aside from these two elements, he still must carry a substantial overhead burden comparable to that of service businesses that operate from recognized business locations and subscribe to business-telephone service.

The independent dealer must finance everything for himself that would be financed by his employer if he were working for someone else. Out of his gross income for his time and the gross profit from the tubes, parts, and equipment he sells in the course of his work, he should be able to pay himself a salary or wage that would be equal to or better than he could earn by working for someone else. Taking precedence over his personal income, his business must pay the operating and maintenance expenses of his vehicle plus a reserve to replace it when it wears out. It should permit him to lay aside additional reserves to replace his test instruments and tools when they wear out or become obsolete. Local, state, and federal taxes will take their toll of the dollars a dealer handles in the conduct of his business. For his own and his customers' protection, the dealer must carry several types of insurance policies, each of which will take an annual bite out of the business income. He must certainly allow for these.

A prudent man operating his own business will try hard to give himself and his family the fringe benefits and security protection at least equal to those he would receive as an employee on someone else's payroll. This would include life insurance, hospital and surgical insurance, and some provisions for annual vacations. The money to pay these things, of course, must come from the usable income produced by the business.

In analyzing the prospect for survival of a small, independent service business, these are some of the pertinent questions that must be considered: (1) What volume of business must it handle to provide an operating profit that will take care of *all* operating expenses and give the operator a normal or average income? (2) How can this volume of business be maintained? (3) Can the dealer himself handle all of the productive work and, at the same time, take care of all of the non-income-producing details inherent in managing a business?

Extensive studies made of electronic service business operations about seven years ago indicated that, at that time, the most efficient size for a service business was a four-man operation plus a carefully selected and well trained telephone receptionist. In this ideal type of operation, the force included two men who devoted all of their time to home service calls, a good bench man who could also handle any overload of home service calls, and a shop owner who was an effective combination of businessman and electronic technician.

Since this survey was made, several very important changes have occurred in the economics of service-business operation. There has been a steady increase in the percentage of business income absorbed by taxes. Hand-in-hand with these tax increases, the cost of living and all of the costs of operating a business have risen. Then, attacking service income from another direction, self-service tube testers are reaching out to take away a substantial percentage of the simpler and more profitable service jobs.

These developments have placed the independent in a three-directional

(*Continued on page* 135)

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The Heathkit amplifier standards have been established upon these following beliefs after reviewing over one hundred published treatises on the subject:

WE BELIEVE any amplifier should be rated for its intended use . . .

PROFESSIONAL amplifiers must be so nearly perfect that no audible change occurs in the program material.

HIGH FIDELITY amplifiers must be almost as perfect, almost as efficient.

UTILITY amplifiers can be less perfect and still fulfill their practical job.

WE BELIEVE the rated power of an amplifier in any of the above "use" categories should be that power which satisfies all requirements in that category.

Each of the three "use" categories we have chosen has requirements which can be translated into performance specifications with rather definite limits . . . limits established by recognized authorities. The Heath requirements and their limits for each of the categories are as follows:

PROFESSIONAL RATING

The professional power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.3% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20,000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 20 and 20,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 1.0% (60 and 6000 CPS, 4:1).

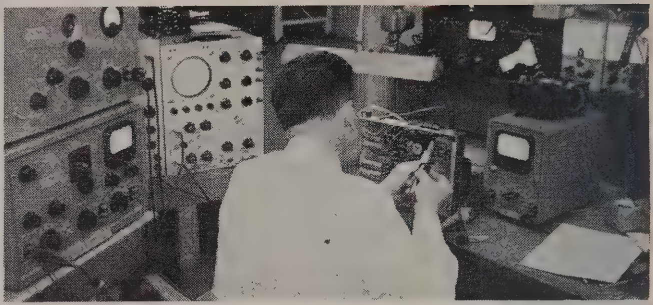
HIGH FIDELITY RATING

The high fidelity power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.7% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 30 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 15,000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 30 and 15,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 2.0% (60 and 6000 CPS, 4:1).

UTILITY RATING

The utility power rating shall be that power which satisfies the following five tests:



1. Maximum power at which total harmonic distortion (THD) does not exceed 1.0% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 60 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 7000 CPS.
4. Maximum power at which response does not deviate by more than ±1 db between 60 and 7000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 3.0% (60 and 6000 CPS, 4:1).

We at the Heath Company are now rating all our amplifiers to these standards. To show you just how this rating system works, let's look at the Heathkit EA-3 amplifier:

As a professional amplifier—

1. Maximum Power at which T.H.D. does not exceed 0.3% at 1000 CPS: 15.1 watts
2. Maximum Power at which T.H.D. does not exceed 2.0% at 20 CPS: 13.9 watts
3. Maximum Power at which T.H.D. does not exceed 2.0% at 20,000 CPS: 15.3 watts
4. Maximum power at which response does not deviate more than ±1 db between 20 and 20,000 CPS: 17.6 watts.
5. Maximum equivalent single-frequency power at which intermodulation distortion (60 and 6000 CPS, 4:1) does not exceed 1%: 18.0 watts.

Taking that power which satisfies all five tests, we could rate the EA-3 for professional use, at 13.9 watts. Its advertised professional rating is a conservative 12 watts.

A review of the chart below shows why the EA-3 is rated at 14 watts for high fidelity applications, and 16 watts as a utility amplifier.

Notice that our specifications are set at rated power for one or more classifications (when our customers need an amplifier for a particular use, we believe thay want it to deliver its rated power under those particular conditions). Observe that our distortion figures are specified at the limits of the amplifier frequency range as well as at the traditional 1000 CPS (the common practice of rating distortion only at 1000 CPS does not tell you what happens throughout the full range of the amplifier).

As an example of how these standards work on several competitive amplifiers, we have prepared the following chart. Notice that if the amplifiers did not meet standards at rated output power, we have determined the power output where they do meet the standards set up under the three categories.

AMPLIFIER COMPARISON CHART

Amplifier Description and Price	Heath Standard Rating		Maximum Power Output Satisfying:				
	Classification	Power (watts)	Power Rating at Test 1 Stds.	Power Rating at Test 2 Stds.	Power Rating at Test 3 Stds.	Power Rating at Test 4 Stds.	Power Rating at Test 5 Stds.
Kit "A" "12 w. HI FI" $23.90	Professional	Disqualified	8.4 watts	0.02 watts	0.65 watts	Disqualified	3.9 watts
	High Fidelity	Disqualified	9.1	1.3	1.67	Disqualified	5.9
	Utility	8.6 watts	9.8	8.9	8.6	12.3 watts	11.6
Assembled Amp. "B" "14 w. HI FI" $39.50	Professional	0.3	4.7	0.3	4.8	1.2	4.0
	High Fidelity	1.1	12.1	1.1	5.7	5.3	8.2
	Utility	7.8	13.2	7.8	12.9	15.8	13.9
Kit "C" "12 w. HI FI" $34.95	Professional	3.6	11.0	3.6	7.5	7.5	6.5
	High Fidelity	8.0	11.8	8.0	11.2	13.4	14.3
	Utility	11.9	12.0	12.0	11.9	15.0	14.9
Assembled Amp. " D" "15 w. HI FI" $64.50	Professional	3.8	13.2	3.8	14.5	12.0	14.6
	High Fidelity	10.6	14.3	10.6	14.5	18.3	16.3
	Utility	14.7	14.7	14.7	15.0	23.7	17.0
Heathkit EA-3 "14 w. HI FI" $29.95	Professional	13.9	15.1	13.9	15.3	17.6	18.0
	High Fidelity	15.5	16.2	15.8	15.5	18.3	18.9
	Utility	16.4	16.5	16.6	16.4	19.0	19.5

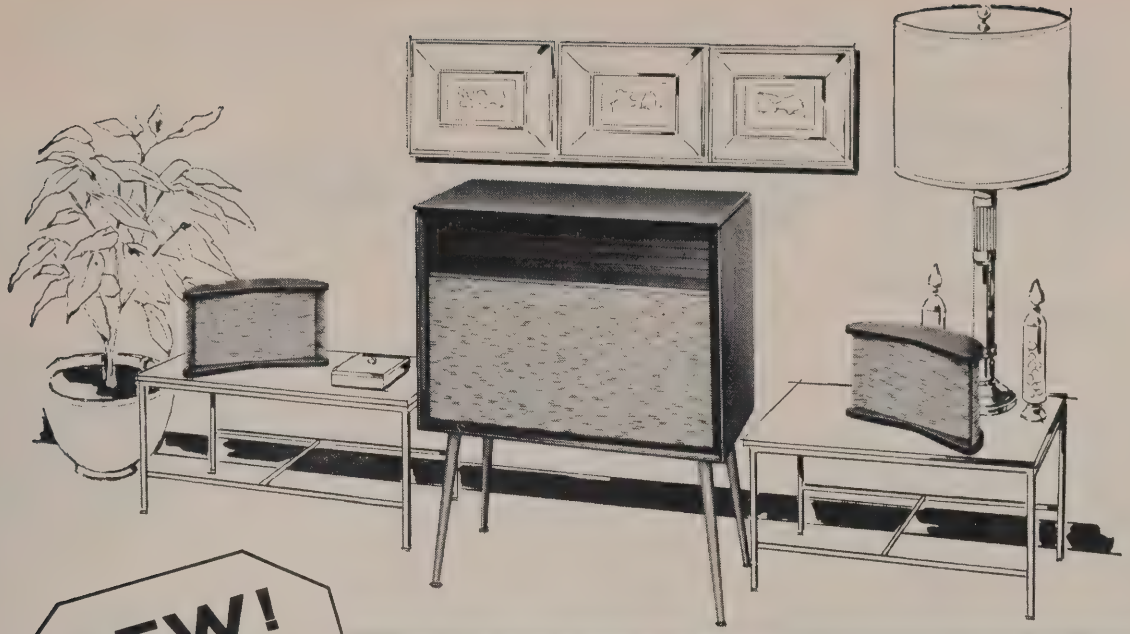
The Heathkit amplifier power rating standards have been established as further assurance to you of the high quality of our products. We will live by these standards until industry-wide standards are established.

HEATHKIT®

HEATH COMPANY

Benton Harbor 15, Michigan

a subsidiary of Daystrom, Inc.



NEW!
from the
HEATHKIT
AUDIO LABS

BRAND NEW!
a complete Heathkit Stereo "Package"

THRILL TO A NEW DIMENSION
IN STEREO SOUND

HEATHKIT SD-1 B (birch
or SD-1 M (mahogany)

$\$179^{95}$

(cabinet legs included;
end tables not included)

HI-FI STEREO SYSTEM KIT

For the first time anywhere . . . a stereo-kit package, ready-to-play after only a few hours assembly time and complete with cabinet, stereo amplifier, stereo record changer, bass woofer and stereo speaker wings. And the unbelievably low price sets an unprecedented record for stereophonic systems of this quality anywhere on the market. One of the factors behind this phenomenal achievement is the introduction of the revolutionary stereophonic "sum and difference" amplifier used in this kit—licensed in kit form exclusively by Heath Company from CBS Laboratories. This unique development in audio science employs a new principle of stereophonic reproduction. The single chassis amplifier separates the individual stereo channels by utilizing the sum and difference of the total signal and directing the sound to the appropriate right and left channels, reproduced by the stereo wing speakers. The centrally located woofer reproduces the non-directional bass frequencies. The result of this modern stereo reproduction is a breathtaking experience of sound coming to you with depth and direction seldom achieved by conventional stereophonic methods. The beautifully styled console cabinet houses the stereo amplifier, stereo record changer and low-frequency woofer. Controls on the handsome black and gold amplifier panel consist of: on-off switch, bass and treble tone controls, input selector switch and level balancing control. The new CBS sum-and-difference or matrix-type circuit employs only four tubes and is extremely easy to assemble. The woofer, mounted behind the attractive grille cloth, is a high compliance 8″ speaker capable of 30 cycle response when housed in the acoustically designed ducted-port enclosure. The specially designed crossover employs a dual bass-mixing 250 cycle network. The twin stereo speakers are 6″ x 9″ extended range dual cone oval speakers. The completely automatic, four speed record changer employs a ceramic stereo cartridge with micro-groove diamond stylus capable of obtaining the best from the latest stereo or LP monophonic recordings. A 45 RPM spindle is also included for 45 RPM monophonic or stereo records. Separate inputs are provided for AM/FM tuners or multiplex. Both in styling and performance, the all-new SD-1 Stereo offers you the greatest Heathkit value in years. Shpg. Wt. 88 lbs.

- Complete—No "Extras" to Buy
- Revolutionary Stereo Amplifier
- Assemble in Just a Few Hours From Easy Step-By-Step Instructions
- Beautifully Styled Cabinetry
- Stereo Sound With Such Impact You'll Find It Hard to Believe!

SPECIFICATIONS—Overall System Frequency Response: ±5 db, 30-16,000 cps. Amplifier: (push-pull conditions except where specified). Power versus Distortion: 10 watts, less than 3% THD from 30-16,000 cps. 9 watts, less than 2% THD from 30-16,000 cps. 1 watt, less than 0.7% from 30-16,000 cps. Peak Power: 20 watts: Mid-range individual channel power, 5 watts. Frequency Response: Tuner input, tone controls in mid-position, 1 watt level, ±1 db, 30-16,000 cps. Ceramic cartridge input—equalized for RIAA characteristics. Input Sensitivity: 0.1 volt at 1000 cps to each tuner input for 10 watt output. Hum and Noise: 70 db below 10 watt level with inputs shorted. Channel Separation at Significant Frequencies: (2 watt level on operating side). 250 cps—29.0 db. 1 kc—34.0 db .2 kc—35.0 db. 2 kc—35.0 db. 5 kc—36.0 db. 8 kc—37.0 db. 12 kc—35.0 db. 16 kc—29.0 db. Overall Channel Separation: using RCA test record #1427-1, cartridge supplied, 1000 cps, 20 db. Bass Tone Control 50 cps: accentuation 8 db. Attenuation 9 db. Treble Tone Control 10 kc: accentuation 9 db. Attenuation 7 db. Power Requirements: 117 volts, AC, 60 cycles, 75 watts. Crossover Network: crossover freq.—250 cps. Attenuation rate 12 db per octave. Power rating—5 watts per channel. Changer: speeds —16, 33⅓, 45, 78 rpm. Cartridge: ceramic stereo, out-of-phase connected (.0008″ diamond stylus). Cabinets: dimensions—main cabinet, 30″ wide x 34½″ high x 15″ deep. Satellite speaker, 14¼″ wide x 8″ high x 6½″ deep.

EASY TIME PAYMENTS

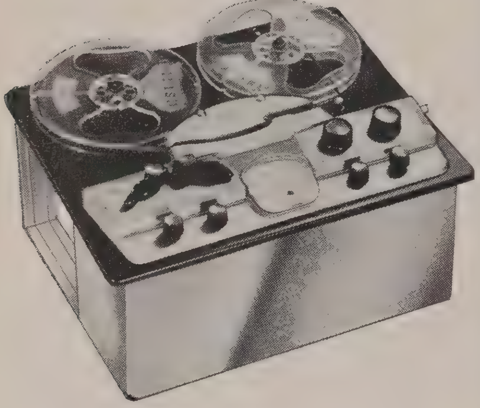
The thrills of stereo sound from this New Heathkit Stereo System can be yours NOW . . . while you pay in easy installments.

a complete line of stereophonic and monophonic

NEW! from the HEATHKIT AUDIO LABS

HEATHKIT Tape Recorders

Field Tested for One Year



SPECIFICATIONS—Tape Speed: 7.5 and 3.75" per second. Maximum reel size: 7". Frequency response: (record-playback): ±2.5 db, 30-12,000 cps at 7.5 IPS. ±2.5 db, 30-6,500 cps at 3.75 IPS. Harmonic distortion: 1% or less at normal recording level; 3% or less at peak recording level. Signal-to-noise ratio: 50 db or better, referred to normal recording level. Flutter and wow: 0.3% RMS at 7.5 IPS, 0.35% RMS at 3.75 IPS. Heads (3): erase, record, and in-line stereo playback. Playback equalization: NARTB curve, within ±2 db. Inputs (2): microphone and line. Input impedance: 1 megohm. Outputs (2): A and B stereo channels. Output levels: approximately 2 volts maximum. Output impedance: Approximately 600 chms (cathode followers). Recording level indicator: professional type db meter. Bias-erase frequency: 60 kc. Timing accuracy: ±2%. Power requirements: 105-125 volts AC, 60 cycles, 32 watts. Dimensions: 15½" W. x 13½" D. total height 10¾". Mounting: requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

NEW PROFESSIONAL-TYPE TAPE RECORDER KITS

Designed to take their place in the finest of hi-fi systems, the new models TR-1C and TR-1D Tape Recorders will provide superb performance for years to come. These completely field tested, precision engineered instruments provide monophonic record and playback in the TR-1C or monophonic record and playback plus stereo playback in the TR-1D.

The mechanical assembly, with fast forward and rewind, is completely finished and adjusted—you build only the tape amplifier. Easy to assemble, the amplifier features two circuit boards which virtually eliminate wiring errors and assure the high stability necessary for consistently good results.

Low noise EF-86 tubes in input stage and push-pull bias erase oscillator assure maximum freedom from hum and noise in recording and playback.

Two inputs are provided (mike and high level line) for recording from microphone, preamplifier, tuner, phono, or TV. In the TR-1D, a separate playback channel with cathode follower output is provided for each stereo track—one of the stereo channels is used for monophonic playback.

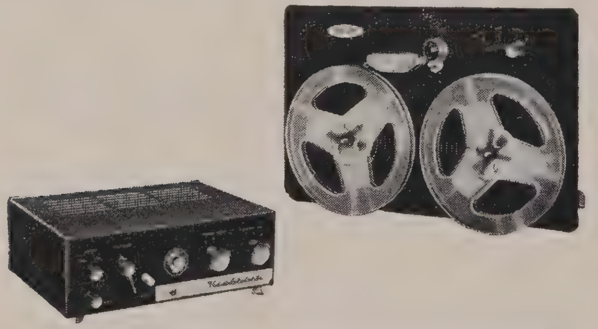
Separate record and playback heads and amplifiers allow monitoring from tape while recording. Built-in sound level meter indicates proper recording level and bias for top quality recordings. A pause control allows instant starting and stopping of tape for accurate cueing and tape editing. Kit includes counter for cueing and editing ease.

The precision tape mechanism features heavy duty fan cooled motor, balanced flywheel, long-life bearings, and positive acting braking system. Push button provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch minimizes the possibility of accidental erasing. The handsome styling includes plastic escutcheon in soft gold mounted on semi-gloss black panel with black knobs with gold inserts. Complete instructions provided for assembly and operation. This outstanding kit offers a combination of features found only in higher priced professional tape decks selling for $350 to $400.

MODEL TR-1C Monaural Tape Deck: Has all features of model TR-1D with the exception of stereo playback. Shpg. Wt. 30 lbs. **$159.95**

MODEL TR-1D Stereo Tape Deck: Provides monaural record and playback and stereophonic playback of the pre-recorded tapes (stacked). Shpg. Wt. 30 lbs. **$169.95**

MODEL C-TR-1C Conversion Kit: Converts model TR-1C to include stereo function of model TR-1D. **$19.95**



NOW! TWO NEW STEREO-MONO TAPE RECORDERS IN THE TR-1A SERIES

Our most versatile tape recorder kit, the model TR-1A now can be purchased in any one of three versions. You can buy the new half-track (TR-1AH) or quarter-track (TR-1AQ) versions which record and play back stereo and monophonic programming, or you can buy the original monaural version (TR-1A) and add either half-track or quarter-track stereo provisions later using the MK-4 or MK-5 Conversion kits. The tape deck is extremely simple to assemble and uses precision bearings throughout the rugged mechanism assuring long and faithful service. One control lever selects all tape handling functions on the deck, greatly simplifying operation. Speeds of 7.5 or 3.75 IPS are available. Flutter and wow are held to less than 0.35%. Each tape preamplifier features NARTB playback equalization, separate record and playback gain control, cathode follower output and provision for mike or line input. Record level is indicated on "magic eye" tube. A safety interlock is provided to minimize accidental erasure of tape. Filament balance control allows adjustment for minimum hum level. Cathode follower output from playback channel is approximately 600 ohms impedance. Two circuit boards are used for easy assembly. Supplied with attractive vinyl-clad steel cover in black leather texture, with inlaid gold design. Templates and instructions provided for panel mounting or equipment enclosure installation.

NOW AVAILABLE IN THREE MODELS!

MODEL TR-1A: Monaural record/playback with fast forward and rewind functions. Shpg. Wt. 24 lbs. **$99.95**

TR-1A SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 50-12,000 cps. 3.75 IPS ±3 db 50-7,000 cps. Signal to Noise Ratio: Better than 45 db below full output of 1.25 volts/channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency: 60 kc (push-pull oscillator).

MODEL TR-1AH: Monaural and half-track stereo record/playback with fast forward and rewind functions.
Shpg. Wt. 35 lbs. **$149.95**

TR-1AH SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 45 db below full output of 1 volt/channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency: 55 kc (push-pull oscillator).

MODEL TR-1AQ: Monaural and quarter track stereo with record/playback fast forward and rewind functions.
Shpg. Wt. 35 lbs. **$149.95**

TR-1AQ SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 40 db below full output .75 volts/channel. Harmonic Distortion: Less than 2% at full output. Bias Erase: 55 kc (push-pull oscillator).

NOW! FULL STEREO CONVERSION FOR TR-1A OWNERS

MK-4 Half-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of half-track stereo program material. Consists of a TE-1 tape preamplifier, a stereo head array plus components and instructions to convert TR-1A to TR-1AH. **$62.95**

MK-5 Quarter-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of quarter-track stereo. Allows playing stereo both ways on standard tape for twice the playing time or four times playing time with monophonic recordings. Consists of a TE-1 tape preamplifier, a stereo head array plus components and instructions to convert TR-1A to TR-1AQ. **$62.95**

HEATHKIT®

monophonic or stereo Hi-Fi

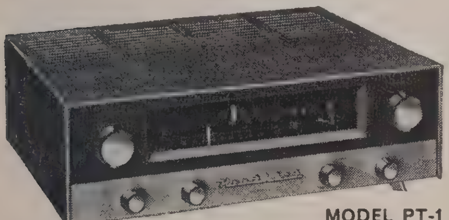
HEATHKIT Program Sources

NEW

MODEL FM-4

$\$34^{95}$

SPECIFICATIONS—Tuning Range: 88—108 mc. Quieting Sensitivity: 2.5 uv for 20 db of quieting. 3.5 uv for 30 db of quieting. 25 uv for maximum quieting (45 db). IF Frequency: 10.7 mc. Image Ratio: 45 db. AFC Correction Factor: 75 kc per volt. AM Suppression: 25 db. Frequency Response: ±2 db 20-20,000 cps. Harmonic Distortion: Less than 1.5%, 1100 uv, 400 cycles 100% modulation. Intermodulation Distortion: Less than 1%, 60 cycle and 6 kc mixed 4:1 1100 uv, 30% modulation. Antenna: 300 ohms unbalanced. Output Impedance: 600 ohms (cathode follower). Output Voltage: nominal .5 volt (with 30% modulation, 20 uv signal). Power Requirements: 105-125 volts 50/60 cycle AC at 25 watts. Overall Dimensions: 4¼" H. x 13¼" W. x 5½" D.



MODEL PT-1

$\$89^{95}$

MODEL BC-1A

$\$26^{95}$

HIGH FIDELITY AM TUNER KIT (BC-1A)

Delivers AM broadcast reception comparable to FM quality. Features a special detector using crystal diodes and broad-band IF circuits for low signal distortion. Prealigned RF and IF coils eliminate the need for special alignment equipment. Sensitivity better than 3 microvolts for one volt output. Two output levels provided. Built-in power supply. Special antenna supplied, also provision for outside antenna. Shpg. Wt. 9 lbs.

MODEL FM-3A

$\$26^{95}$

HIGH FIDELITY FM TUNER KIT (FM-3A)

Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Incorporates stabilized temperature compensated oscillator, built-in power supply, prealigned IF transformers and ratio detector. The pre-assembled tuning unit is pre-aligned. Two output levels provided. Shpg. Wt. 8 lbs.

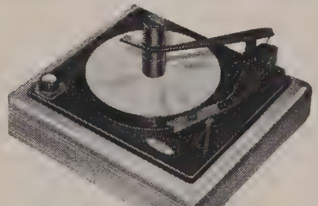
NEW HIGH FIDELITY FM TUNER KIT (FM-4)

This superbly designed unit incorporates advancements in circuit design with features asked for by hi-fi fans everywhere. Better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with defeat switch, flywheel tuning and prewired, pre-aligned and pretested tuning unit . . . bring you the finest in FM listening entertainment. The exceptionally clean chassis layout, prealigned IF transformers and the prewired, pre-aligned tuning unit insure ease of construction with no further need of alignment after the unit is completed. The five tube circuit features a generous power supply utilizing a silicon diode rectifier for cool running operation and low power consumption. The attractive styling of the FM-4 features a vinyl-clad steel cover with leather-like texture, soft black front panel, set off with brushed-gold trim and new soft evenly-lit dial scale. A multiplex adapter output is provided. Feature for feature the FM-4 offers the most outstanding dollar value in FM entertainment available today. Shpg. Wt. 8 lbs.

MONOPHONIC-STEREO AM-FM TUNER KIT (PT-1)

Outstanding features in both styling and circuitry are combined in this 16-tube deluxe stereo AM-FM combination tuner to bring you the very finest of program sources for your listening enjoyment. Features include three printed circuit boards for easy construction and high stability—wired, prealigned 3-tube FM tuning unit—built-in AM rod antenna—tuning meter—automatic frequency control (AFC) with on-off switch—and flywheel tuning. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. AM and FM circuits are separate and individually tuned so they can be used simultaneously for stereo applications. Cathode follower outputs with individual level controls are provided for both AM and FM, with a multiplex adapter output provided. A tuning meter and flywheel tuning combined with two edge-lit slide rule scales provide effortless tuning. Styling features vinyl-clad steel cover in black with inlaid gold design and soft black, rigid die-cast panel set off by brushed gold trim, black knobs with gold inserts. Shpg. Wt. 24 lbs.

AUTOMATIC HI-FI RECORD CHANGER KIT (RP-3)



Combining automatic convenience with turntable quality through unique and simple design the Heathkit RP-3 handles your records with the finest of care for full fidelity reproduction. The unique "turntable pause" feature during change cycle and smooth friction clutch start prevents record damage. Proper weight distribution and low pivot point friction of the tone arm minimize arm resonance, tracking error, and record wear. All record changer kits come equipped with changer base, stylus pressure gauge, 45 RPM spindle, and necessary wire.

STEREO MODEL RP-3S: Equipped with Shure diamond stylus magnetic cartridge providing frequency response of ±4 db from 30 to 14,000 CPS. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3-LP: (monaural microgroove recordings only): Equipped with Fairchild Magnetic diamond stylus cartridge. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3: Features a GE VRII magnetic cartridge with diamond LP and sapphire 78 stylus. Shpg. Wt. 19 lbs. **$64.95**

SPECIFICATIONS—Operates from: 105-130 volts 60 cycles. Wow and Flutter: Less than 0.18% peak at 33-1/3 RPM. Turntable Speed: Accurate within ±2%. Change Cycle: Completed in 9 seconds. Dimensions: 13½" wide x 12" deep. 5" above and 3" below mounting board. Motor Type: 4 Pole hum shielded. Type of Drive: Friction. Record Speeds: 4 speeds. Automatic and manual 33-1/3, 45, 78 RPM. Manual only—16 RPM. Variations in Tracking Force: Less than 0.9 gram from first record to tenth record. Controls: "ON-OFF" switch. Manual Reject. "Speedminder" (automatic speed selection and indexing). Manual speed selector (4 speed). Finish: Midnight Gray. Base: Maple (unfinished). Mounting Board: Birch (unfinished).

NEW
from the
HEATHKIT
AUDIO LABS

a complete line of monophonic and stereo

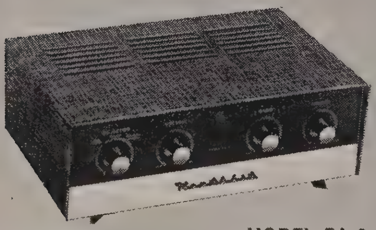
HEATHKIT® Hi-Fi Amplifiers

MODEL SA-3

NEW $\$29^{95}$

MODEL EA-1

NEW $\$15^{95}$



MODEL EA-3

NEW $\$29^{95}$

NEW "ECONOMY" STEREO AMPLIFIER KIT (SA-3)

The all-new Heathkit SA-3 Stereo Amplifier has all the convenience of complete dual channel control at a fraction of the cost of comparable equipment. High level preamplifier section of the SA-3 provides complete control for both channels. Ganged tone controls provide "boost" and "cut" for base and treble. Dual concentric volume controls make possible precise channel balancing. A channel reversing switch and a speaker phasing switch allows optimum performance. Two separate inputs are provided for each channel to accommodate ceramic cartridge phonographs, AM-FM tuners, or tape recorder. Program source may be reproduced in either monophonic or stereo form. A really big package of stereo performance for the small investment! Shpg. Wt. 13 lbs.

SPECIFICATIONS: Power Output: 3 watts per channel, Utility Rating. **Power Response:** ± 1 db 60 cps to 20 kc at 3 watts output. **Total Harmonic Distortion:** less than 3% 60 cps to 20 kc at 3 watts output. **Intermodulation Distortion:** less than 3% at 3 watts output using 60 cycle and 6 kc signal mixed 4:1. **Hum and Noise:** 65 db below full output. **Controls:** dual clutched volume, ganged treble, ganged bass, 7 position selector, speaker phasing switch, on-off switch. **Inputs:** (each channel) tuner, crystal or ceramic phono. **Outputs:** (each channel) 4, 8, and 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12½" W. x 6¾" D. x 3¼" H.

NEW "ECONOMY" 3 WATT AMPLIFIER KIT (EA-1)

More than enough for room filling volume . . . ideal for getting started on a low cost individual component system. Designed for use with ceramic cartridge record players, tuners, tape recorders, etc. Built-in preamplifier provides you with all the necessary tone and volume controls for adjusting the sound reproduction to your personal taste. Smart appearance, quality components, assemble it in a few hours for years of trouble-free enjoyment. Shpg. Wt. 7 lbs.

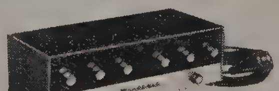
SPECIFICATIONS: Power Output: 3 watts, Utility Rating. **Power Response:** ± 1 db 60 cps to 20 kc at 3 watts output. **Total Harmonic Distortion:** less than 3%, 60 cps to 20 kc at 3 watts output. **Intermodulation Distortion:** less than 3% at 3 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and Noise:** 70 db below full output. **Power Supply:** transformer operated full wave rectifier. **Inputs:** (2), crystal or ceramic phono cartridge, tuner. **Input Sensitivity:** 100 mv for 3 watts output. **Output Impedance:** 4, 8, and 16 ohms. **Dimensions:** 3¾" H. x 9½" W. x 6" D.

NEW 14-WATT HI-FI AMPLIFIER (EA-3)

From HEATHKIT audio labs comes an exciting new kit . . . New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the preamplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste. Clearly marked controls give you finger-tip command of bass and treble "boost" and "cut" action, switch selection of three separate inputs, "on-off" and volume control. A hum balance control is also provided.

NOTE THESE OUTSTANDING SPECIFICATIONS: Power Output: 14 watts, Hi-Fi; 12 watts, Professional; 16 watts, Utility. **Power Response:** ± 1 db from 20 cps to 20 kc at 14 watts output. **Total Harmonic Distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation Distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and Noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts.

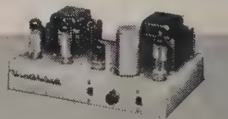
PREAMPLIFIERS



Model WA-P2 "Master Control" hi-fi preamplifier kit. 7 lbs.	$19.75
Model SP-2 Mono-Stereo (2 channel mixer) Preamplifier kit. 15 lbs.	$56.95
Model SP-1 Single Channel version of SP-2. 13 lbs.	$37.95
Model C-SP-1 Converts SP-1 to SP-2. 5 lbs.	$21.95

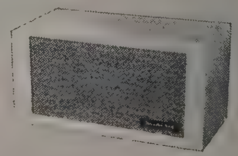
HEATHKIT®

POWER AMPLIFIERS



Model UA-1 "Universal" hi-fi 12-watt amplifier kit. 13 lbs.	$21.95
Model W-4AM Single Chassis 20-watt hi-fi amplifier kit. 28 lbs.	$39.75
Model W-3AM Dual Chassis hi-fi 20-watt amplifier kit. 29 lbs.	$49.75
Model W-7M "Extra Performance" hi-fi 55-watt amplifier kit. 28 lbs.	$54.95
Model W-5M high fidelity 25-watt amplifier kit. 31 lbs.	$59.75
Model W-6M high fidelity 70-watt amplifier kit. 52 lbs.	$109.95

SPEAKER SYSTEMS



Model SS-3 "Basic" fir hi-fi speaker system kit. 26 lbs.	$34.95
Model SS-2 "Basic Range" hi-fi speaker system kit. 26 lbs.	$39.95
Model SS-1B "Range Extending" hi-fi speaker system kit. 80 lbs.	$99.95
Model HH-1 "Legato" hi-fi speaker system kit. 195 lbs.	$299.95

HEATH COMPANY, Benton Harbor, Michigan
a subsidiary of Daystrom, Inc.

NEW: Heath Now Puts 2-Way Radiotelephone Communications in Reach of Everyone

Citizen's Band Transceiver Kit

NEW: No Radio Operators License Necessary!

NEW
from the
HEATHKIT
COMMUNICATIONS
LABORATORIES

- Designed to meet all FCC requirements for new 11-meter "Citizens Band" class D operation.
- Any U.S. citizen 18 or older eligible for license.
- No theory to study—no tests to take.
- Hundreds of uses in business or pleasure.
- Top quality components—proven performance—easy to build.

SPECIFY FREQUENCY CHOICE

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc
26.975 mc
26.985 mc
27.005 mc
27.015 mc
27.025 mc
27.035 mc
27.055 mc
27.065 mc
27.075 mc
27.085 mc
27.105 mc
27.115 mc
27.125 mc
27.135 mc
27.155 mc
27.165 mc
27.175 mc
27.185 mc
27.205 mc
27.215 mc
27.225 mc
*27.255 mc

*This channel shared with Class C Radio Control.

NEW

CITIZEN'S BAND TRANSCEIVER
HEATHKIT

MODEL CB-1
Includes transceiver, microphone, and special power cords.

$42.95

First and only kit of its kind . . . designed to meet all FCC requirements for two-way radio telephone communication on new class D 11-meter "citizens band" . . . any U.S. citizen eighteen or older eligible for license . . . no code test, no radio theory exams, no knowledge of specialized operating procedures required . . . just fill out simple form included with kit and mail to FCC for registration. The Heathkit CB-1 Transceiver is light, compact, simple to assemble, easy to use. Buy two or more units, have your own communications system . . . talk with family, friends, associates from your car, home, boat or office . . . cover distances from one to ten miles depending on location and type of installation (extensively field tested). A flick of a switch selects "transmit" or "receive" while single receiver tuning control selects any of 23 assigned channels . . . third knob controls volume and turns set on and off. With separate vibrator power supply available from Heath, along with two special power cords included with kit, you can convert transceiver from fixed location at home or office to mobile operation in cars, boats, etc., in minutes, after initial installation, with no tools or adjustments. There's a Heathkit accessory antenna for any application, mobile or fixed. Kit comes complete with microphone, station identification card which fits in plastic window at end of cabinet, all pertinent FCC regulations and application forms, a sheet of adhesive-back letters and numbers to affix call letters in space provided on front panel, and crystal for one channel. Specify your frequency choice or we will supply crystal of appropriate frequency. The famous Heathkit quality coupled with the market-shattering low price of this kit make it truly a value of a lifetime. Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver Type: Superregenerative detector w/rf stage. Power Input: 5 watts to plate of final RF amplifier (FCC maximum). Transmitter Frequency Control: Third overtone type quartz crystal operating within 0.005% of marked channel frequency between 32 F and 140 F. Modulation: AM plate modulation automatically limited to less than 100% (FCC requirements). Power Supply: 117 V 50/60 cycle, AC. 6 V battery using Model VP-1-6 Vibrator Power Supply or 12 V battery using Heathkit VP-1-12. Power Requirements: 117 volts 50/60 cycle AC 35 watts; 6 V battery w/VP-1-6, 6.5 amps., 12 V battery w/VP-1-12, 4.0 amps. Total B + requirements, 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.8 amps. or 12.6 volts at 0.9 amps. Power Rectifier: 2 silicon diodes in full wave voltage doubler circuit. Microphone: Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. RF Output Impedance: 50 ohms. Speaker Size: 4 inch (round). Undistorted Audio Power Output: Approximately 1 watt. Line Cords: Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. Cabinet Dimensions: 8" H. x 6" D. x 9¾" W.

ANTENNAS

MODEL CBU-1 "UTILITY" ANTENNA

Low cost, portable antenna for CB-1 Transceiver for temporary installations, mobile or fixed, where maximum coverage is not required. Rugged clip for mounting on eaves-trough of house or rain gutters of cars, trucks, etc. Bracket supplied for mounting on transceiver or any flat surface. 45½" base-loaded, antenna with 12′ connecting cable comes complete, ready to use. Shpg. Wt. 3 lbs.
$9.95

MODEL CBM-1 "MOBILE" ANTENNA

For CB-1 Transceiver permanent mobile installations where greatest coverage is desired. Easy to install double chain-type bumper mount spring base—no cutting or drilling. Easily adapted to boats, etc. ¼ wave whip antenna approximately 9′ from mounting surface to tip—supplied with clip for securing in semi-horizontal position to clear obstructions. Kit is complete with 102" whip in 2 sections, 15′ connecting cable and all necessary hardware. Shpg. Wt. 7 lbs.
$19.95

MODEL CBF-1 "FIXED LOCATION" ANTENNA

A ¼ wave "ground plane" type antenna for CB-1 Transceiver using 4 radial elements as the "ground plane" and 1 vertical element as the radiator. Excellent coverage, essentially non-directional, making it ideal for communications between fixed and mobile units. Antenna measures 9′ 4" from bottom of mounting bracket to top of vertical radiator. Radial length 9′. Kit is complete with 50′ connecting cable and easy to install mounting clamp. Shpg. Wt. 7 lbs. **$19.95**

POWER SUPPLIES FOR MOBILE USE OF CB-1:

MODEL VP-1-6 Vibrator Power Supply kit for 6 volt batteries. Shpg. Wt. 4 lbs.
$7.95

Model VP-1-12 Vibrator Power Supply kit for 12 volt batteries. Shpg. Wt. 4 lbs.
$7.95

NEW

MODEL CO-1

$7.95

(batteries included)

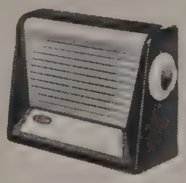
NEW TRANSISTOR CODE PRACTICE OSCILLATOR KIT (CO-1)

Your best buy in a high quality code oscillator, the CO-1 is ideal for Boy Scouts or beginning radio hams. Practice code by authentic CW tone or blinker light. Switch selects built-in speaker or light. Contactor provided for practice keying or any standard key can be connected. Completely transistorized for long battery life. Powered by two standard flashlight batteries. Batteries included. Shpg. Wt. 3 lbs.

TRANSISTOR PORTABLES

. . . and other Do-It-Yourself Hobby Kits

Model XR-1P Transistor Portable Radio kit. . .6 lbs.	**$29.95**
Model CR-1 Crystal Radio kit. . .3 lbs.	**$7.95**
Model BT-1 Battery Tester kit. . .2 lbs.	**$8.50**
Model ET-1 Enlarger Timer kit. . .3 lbs.	**$11.50**
Model BR-2 Broadcast-Band Receiver kit. .10 lbs. . .(less cab.)	**$18.95**
Model RC-1 Professional Radiation Counter kit. . .8 lbs.	**$79.95**



MODEL XR-1P

MARINE KITS . . .

For Fun and Safety Afloat

Model DF-2 Two Band Transistor Radio Direction Finder kit 9 lbs.	**$69.95**
Model FD-1-6 Fuel Vapor Detector kit (6 v.). . .4 lbs.	**$35.95**
Model FD-1-12 Fuel Vapor Detector kit (12 v.). . .4 lbs.	**$35.95**
Model MC-1 Marine Battery Charge kit. . .16 lbs.	**$39.95**
Model PC-1 Power Converter kit. . .8 lbs.	**$24.95**

MODEL DF-2

NEW
from Heath Test Equipment Labs

New—Electronic Ignition Analyzer Kit—IA-1A

MODEL IA-1A
$\$59^{95}$

- A Fraction of the Cost of Comparable Instruments
- Shows "Picture" of Entire Ignition System Performance on Cathode Ray Screen
- Shows Primary or Secondary Circuit Patterns
- "Trouble-Shoot" Complicated Ignition Faults in Minutes

A revolutionary development in the automotive tune-up field. Heathkit offers the small garage owner, service station operator or hobbyist an ignition analyzer with qualities and features of scopes costing several times as much (comparable to instruments costing as much as$750.00). The savings you realize through do-it-yourself kit assembly are only part of the story. Heath engineering know-how and tremendous buying power play an important role in keeping prices at rock bottom. Yet, this scope, as with all Heathkits, is designed to be "beginner built". A few hours of your spare time . . . and you're in business. The IA-1A lets you check the complete ignition system of an automobile in operation by merely connecting two leads to observe the tell-tale spark pattern of the cylinders. Can be used with the car under load and in motion by adding a vibrator power supply. Shows condition of coil, condenser, points, plugs and ignition wiring. A switch selects either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. It will also indicate coil reserve, a poor spark plug, defective wiring and will even identify the offending plug or wire. Also detects breaker point bounce, a defective condenser, or will allow setting of the dwell-time of the points. The IA-1A is simple to use, with a minimum of controls, yet is completely flexible for all types of internal combustion engines with coil ignition and accessible breaker points. Shows complete engine cycle or just one cylinder at a time. Test leads and comprehensive instruction manuals are supplied with kit. Shpg. Wt. 20 lbs.

NEW MODIFICATION KIT FOR OWNERS OF MODEL IA-1 IGNITION ANALYZERS:
Gives you switch selection of either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. Kit includes test lead modification parts and comprehensive instructions for modification and use. Shpg. Wt. 2 lbs. Heathkit MK-6. **$4.95.**

A COMPLETE LINE OF INSTRUMENT KITS

OSCILLOSCOPES

Model OM-3 "General Purpose" 5″ oscilloscope kit. .22 lbs.	**$39.95**
Model O-12 "Extra Duty" 5″ oscilloscope kit. . .22 lbs.	**$65.95**
Model OP-1 "Professional" 5″ DC oscilloscope kit. . .34 lbs.	**$179.95**

METERS

Model V-7A Etched Circuit VTVM kit. . .7 lbs.	**$25.95**
Model AV-3 Audio VTVM kit. . .6 lbs.	**$29.95**
Model MM-1 20,000 ohms/volt VOM kit. . .6 lbs.	**$29.95**
Model AW-1 Audio Wattmeter kit. . .7 lbs.	**$29.50**
Model M-1 Handitester kit. . .3 lbs.	**$17.95**

GENERATORS

Model TS-4A TV Alignment Generator kit. . .16 lbs.	**$49.50**
Model CD-1 Color Bar and Dot Generator kit. . .13 lbs.	**$59.95**
Model SG-8 RF Signal Generator kit. . .8 lbs.	**$19.50**
Model TO-1 RF Test Oscillator kit. . .4 lbs.	**$16.95**
Model LG-1 Laboratory RF Generator kit. . .16 lbs.	**$48.95**
Model AG-9A Audio Generator kit. . .10 lbs.	**$34.50**
Model AG-10 Sine-Square Generator kit. . .12 lbs.	**$49.95**
Model AA-1 Audio Analyzer kit. . .13 lbs.	**$49.95**

TEST INSTRUMENTS

Model TC-3 Tube Checker kit. . .12 lbs.	**$39.95**
Model CC-1 Cathode Ray Tube Checker kit. . .10 lbs.	**$24.95**
Model T-4 Visual-Aural Signal Tracer kit. . .5 lbs.	**$19.95**
Model C-3 Condenser Checker kit. . .7 lbs.	**$19.50**
Model CM-1 Direct Reading Capacity Meter kit. . .7 lbs.	**$29.50**
Model CT-1 In-Circuit Capaci-Tester kit. . .5 lbs.	**$7.95**

Plus many more quality instruments for every need!

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Model DX-40 Phone and CW Transmitter kit. . .25 lbs.	**$64.95**
Model DX-100-B Phone and CW Transmitter kit. . .107 lbs.	**$189.50**
Model VHF-1 "Seneca" VHF Ham Transmitter kit. . .56 lbs.	**$159.95**
Model TX-1 "Apache" Ham Transmitter kit. . .110 lbs.	**$234.95**
Model RX-1 "Mohawk" Ham Receiver kit 66 lbs.	**$274.95**

MOBILE

Model MT-1 'Cheyenne" Mobile Ham Transmitter kit. . .19 lbs.	**$99.95**
Model MR-1 "Comanche" Mobile Ham Receiver kit. . .19 lbs.	**$119.95**
Model MP-1 Mobile Power Supply kit 8 lbs.	**$44.95**
Model PM-2 Power Meter kit. . .2 lbs.	**$12.95**
Model AK-7 Mobile Speaker kit. . .4 lbs.	**$5.95**

NEW EDUCATIONAL ELECTRONIC ANALOG COMPUTER KIT (EC-1)

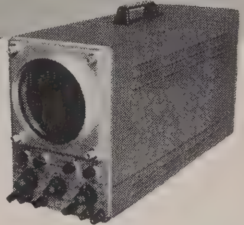
- 9 DC operational amplifiers—3 initial condition power supplies
- 5 coefficient potentiometers—repetitive solution oscillator
- Electronically regulated power supply

NEW from the HEATHKIT INSTRUMENT LABORATORIES

Filling a multitude of needs in the fields of education and electronics, the model EC-1 puts advanced engineering techniques within easy reach of the average individual or institution. An assortment of precision components and patch cords are provided for setting up many complex problems. Solutions are read directly on the panel mounted meter or on an external read-out device such as the Heathkit OR-1 DC Oscilloscope. An informative manual is provided, illustrating operating procedures and basic computer information as well as showing how to set up and solve typical problems. Shpg. Wt. 43 lbs.

HEATHKIT EC-1

$199.95



NEW 5" DC OSCILLOSCOPE KIT (OR-1)

- Identical DC coupled vertical and horizontal amplifiers
- 5ADP2 flat-face CRT—edge-lit graticule
- Transformer operated silicon diode power supply

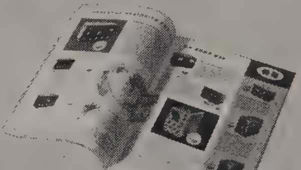
HEATHKIT OR-1

$119.95

Offering all the features of a high quality DC oscilloscope, the model OR-1 is ideal as a read-out indicator in computer applications as well as many types of testing and development work. Features DC to 200 kc (1 db point) bandwidth, 0.1 V (peak-to-peak) per CM sensitivity (uncalibrated). Normal frequency coverage is from 5 to 50 kc in four overlapping ranges. Critical voltages are regulated with gas-filled VR tubes. Coupling may be either AC or DC as selected by the input attenuator switch. Many uses in industrial, educational and medical fields. Shpg. Wt. 21 lbs.

Free Catalog

Over 100 easy-to-build kits are illustrated and described in the latest Heathkit catalog. If you are among the thousands interested in saving one-half or more on hi-fi, test, marine, or ham radio instruments, send for your free copy today.



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. . . an instrument that will excite the entire musical world. Engineered to familiar Heathkit perfection, and styled for the most discriminating taste . . . yet simple to assemble and priced for the average home. Interested? Send your name and address, we'll rush information as soon as available. No obligation.

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Convenient "over-the-counter" delivery is now available through any of the Authorized Heathkit Dealers listed below. Although you will find the price of Heathkits slightly higher when buying locally, we're sure you'll agree that this increase is justified. Your dealer absorbs all transportation charges, carries a complete stock of kits for immediate delivery, provides demonstration facilities, offers you a reliable source for parts and fast service . . . and stands ready to counsel or advise you on any problem that might arise.

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Careful selection of reliable qualified dealers is a slow process . . . so please bear with us if your area has not been covered. Thank you.

HEATH COMPANY
Benton Harbor, Mich.
A Subsidiary of Daystrom, Inc.

Industry Launches Stereo Tape Drive

Over 150 releases on the new 7½-ips, 4-track recorded stereo tape.

STEREO tape gave stereo disc its first serious challenge recently when it was announced that at least 150 releases on the new 7½-ips, 4-track tape would be forthcoming. The announcement was made by Herbert L. Brown newly elected president of the Magnetic Recording Industry Association who said that producers of prerecorded tapes had joined together to launch a wave of two- and four-track stereo entertainment. The 4-track tape wil probably sell for about $6.95 and $7.95 for 30 and 45 minutes respectively o stereo entertainment. Brown, vice-president and manager of *Ampex Audio, Inc.*, said, "The 7½-ips speed was chosen after considerable study t assure continuation of the same high fidelity that has long been associated with magnetic tape recording." With four tracks on the tape instead of the usual two, twice as much music can be recorded on a given length of tape

Brown said that stereo entertainment, which had been known only to sophisticated music lovers and audiophiles, has now become an accepted word in the average American household because of the introduction of the stereo disc. As more and more music lovers become stereo-oriented, an increasing number will be in a position to move toward stereo tape.

The MRIA president also discussed tape cartridges, but emphasized that he felt it might be some time before such cartridges may find widespread use. In the meantime the compatability in reel-to-reel magnetic recordings should be relied on to protect the dealer and the customer.

Brown also spoke out against tape machine imports from Japan as wel as the possibility of a renewed interest in Congress on an excise tax on recording machines. Such a tax would have cost the industry $5-million in the past year. Such an amount would probably be very close to the total net profit for the industry for that period. The executive presented a program for the association for 1959-1960 which included a full-scale public relations and publicity effort. The programs were approved by the membership.

Other officers elected were: Vice-President, Ken Bishop, *Bell Sound* Treasurer, Charles Murphy, *Michigan Magnetics;* Secretary, Herman Kornbrodt, *Audio Devices;* Board of Directors, Hugh Daly, *Magnecord*; Victor A Miller, *V-M Corporation;* Russ Molloy *Bel Canto Magnetic Tapes;* J. Herber Orr, *ORRadio Industries;* Irving Rossman, *Pentron Corporation;* and Harry Sussman, *Telectro Corporation.* —30—

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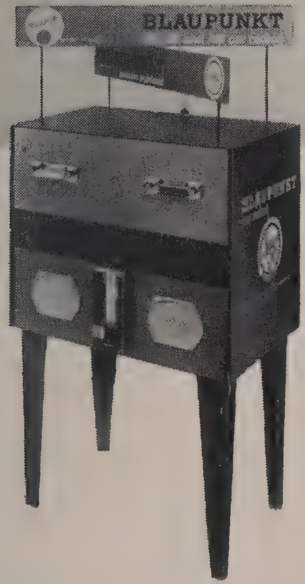

COMPACT DEMONSTRATOR UNIT
Let your customers listen to the rich HI-FI tone of Blaupunkt Car Radios in this demonstrator unit. It's a proven sales-maker, available with the Blaupunkt "Starter Deal."

Here's the precision-engineered car radio that answers the demand for the finest in tonal quality, for reliable, trouble-free performance—available in both FM/AM and AM models. And with the FM/AM Blaupunkt you can offer the powerful plus of uninterrupted static-free reception—no underpass blackout, no fade-out of signal even under bridges or among tall buildings!

EASY TO SELL—the tonal difference does it

EASY TO INSTALL—in American and imported cars

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TUBE PROBLEM:

The Armed Forces needed a new version of the 6J4 reliable tube type which would provide a tube life of almost 1000 hours. Existing tubes of this type had an average life of only 250 hours. In addition, this new tube had to be produced under ultra-high quality control standards.

SONOTONE SOLVES IT:

By making improvements in the cathode alloy and setting up extremely tight controls in precision, manufacture and checking, Sonotone engineers produced a 6J4WA with a *minimum* life of 1000 hours . . . most running *much longer*.

RESULTS:

The Sonotone 6J4WA is one of three reliable tubes now being manufactured under U. S. Army Signal Corps RIQAP (Reduced Inspection Quality Assurance Program), monitored by the U. S. Army Signal Supply Agency. And the same rigid quality standards apply to Sonotone's entertainment type tubes as well.

Let Sonotone help solve *your* tube problems, too.

Sonotone® CORP.

Electronic Applications Division, Dept. TN-89
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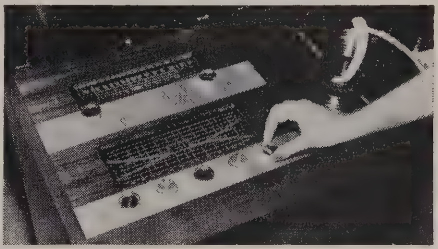
Leading makers of fine ceramic cartridges, speakers, microphones, tapeheads, electron tubes.
In Canada, contact Atlas Radio Corp., Ltd., Toronto

Hi-Fi-Audio Product Review

HOFFMAN "STEREO SCOPE"

Hoffman Electronics Corporation, 3761 S. Hill St., Los Angeles 7, Calif. has developed a new device which permits accurate bass and treble tone control without having to experiment with the controls as each record is played.

The patented "Stereo Scope," developed for use in the firm's new single cabinet stereophonic consoles, shows visually, on a movable graph, the bass and treble decibel setting for each sound channel. By making a note of the desired ratings for each record, listeners can preset the controls when the record is replayed, without having to walk back and forth from their listening positions to make adjustments.



The "Stereo Scope" is calibrated to show actual bass and treble decibel deviation from the sound level at which the record is being played.

SHERWOOD FM TUNER

Sherwood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill. is currently marketing its Model S-3000 II FM tuner which features an "interchannel hush" circuit.

According to the company, the new circuitry makes FM tuning easier by muting noisy "hash" normally heard between channels. The tuner also provides a front-panel control to adjust the degree of silencing (or none at all) offered by the interstation muting action, without affecting the tuner's sensitivity.

Sensitivity is 1 microvolt for 20 db quieting and a.f.c. provides 18 db correction to reduce drift and facilitate accurate tuning. A front-panel a.f.c. disabling switch is incorporated for use when receiving a weak station adjacent to a strong signal. Other features include "feather-ray" tuning eye, multiplex output jack, "local-distant" switch, flywheel tuning, and cathode-follower output.

The circuit uses 9 tubes plus rectifier to provide a response of ±½ db from 20 to 20,000 cps. The tuner measures 14" x 15½" x 4".

PROFESSIONAL TONE-ARMS

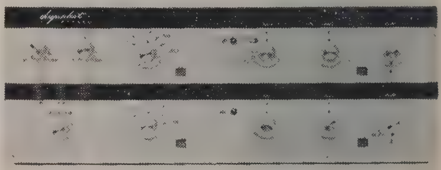
Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has introduced two new professional tone arms, the 16" PK-280 and the 12" PK-270.

Constructed of lightweight, die-cast aluminum, these tone arms utilize four hardened-steel knife-edge pivots and bearings for practically frictionless freedom of motion. An unusual bearing assembly provides minimum waveform distortion and no undesirable motion or loose-jointed action as viewed from the stylus.

Plug-in heads accommodating all stereo and monophonic cartridges are provided. Installation is facilitated by a precise bubble level at the top of the support column. The level, plus three adjustments on the base, make for accurate and trouble-free installation.

PANEL-MOUNTING KIT

Dynaco, Inc., 617 North 41st St., Philadelphia 4, Pa. is now offering a new panel-mounting kit which is designed to be used with two of the firm's preamplifiers and its stereo control kit.



Designated as the PM-2S, the new kit includes a single front escutcheon plate for the three units plus mounting brackets to hold them to the panel. The PM-2S provides the appearance of an integrated stereo preamp while maintaining the flexibility, channel separation, and independence of operation of the individual preamplifiers. It is designed so that no bolt or screw heads are visible from the front of the panel.

A single rectangular hole in the panel takes care of the entire mounting job. The brackets are adjustable to fit any panel thickness up to 1⅛".

JENSEN "GALAXY II" SYSTEM

Jensen Manufacturing Company, 6601 S. Laramie Ave., Chicago 38, Ill. has developed a unique stereo speaker system which is being marketed as the "Galaxy II."

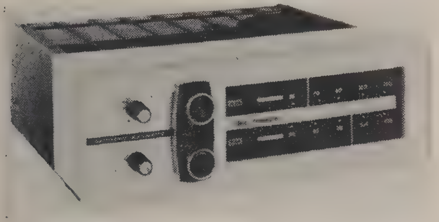
The system comprises a single small "bookshelf" size unit plus two tiny "satellite" speakers which provide the equivalent of two complete 3-way speaker systems with the added feature of a "derived third channel" for center fill. The system consists of the bass-center unit in hardwood cabinet containing the new dual-channel 8-inch "Flexair" woofer, dividing networks for both channels, and terminal-receptacle panel; and two "satellite" units each with yokes and wall-mounting hardware plus 20-foot cord and connecting plug. Satellite units for left and right channels plug into the terminal-receptacle panel on the bass-center unit.

The system will handle 25 watts continuous and 50 watts peak. Frequency range is 40 to 14,000 cps with the bass-center unit handling the 36-350 cps bass range and the 350-1000 cps "center fill" range and each of the satellites covering from 350-2000 cps and 2000-14,000 cps.

The new units are being offered in a choice of walnut, tawny ash, or mahogany finishes. Both assembled and kit versions of the "Galaxy II" are available. Write the manufacturer for a data sheet and full details.

STEREO TUNER

Sargent Rayment Company of Oakland, Calif. is now offering a new dual-channel FM-AM stereo tuner which has been designated as the SR-1000.



The circuit features the company's two-tube AM detector which is said to be capable of reproducing AM with less distortion than FM, a 10 kc. whistle filter, and large ferrite core loop antenna. A two-position AM frequency response control provides for sharp and broad operation.

The FM channel utilizes an advanced gold-plated frame grid cascode tube, low-voltage i.f. tubes for maximum gain and stability, and a fully broadband ratio detector. Special provisions have been made for FM multiplex operation, including output jacks for adapters and wired-in automatic switching.

This new tuner is fully described in the company's 12-page catalogue which is available on request.

MICROPHONE MIXERS

Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill. is currently marketing two new microphone mixers which will handle up to four signals such as microphones, phono, and tuners into a single outlet.

The No. 306 features a "Lev-R-Switch" making it possible to use the unit as a four-channel audio mixer for

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shows

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Why do electronic technicians prefer Quam speakers? In filling out their survey questionnaires, they mentioned such reasons as:

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Thank you, Mr. Serviceman. We appreciate the vote of confidence.

Brand Name Surveys of Chicago, Illinois, asked 22,000 service technicians from coast to coast, "What brand of *replacement* speakers do you prefer?" Overwhelmingly, from Maine to California, the preference was for Quam. In fact, twice as many servicemen now prefer Quam as the next most popular brand—and as many prefer Quam speakers as the other three leading brands combined! This is the fourth consecutive year in which Quam has led the Survey.

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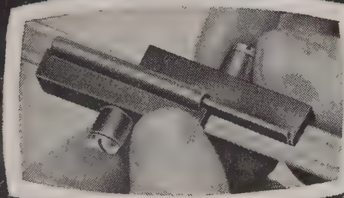

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CONTROL CENTER

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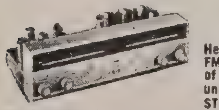
Wired and tested $99.95 Easy-to-build Kit $64.95



ARKAY ST-11 AM-FM
STEREO TUNER

Here, for the first time, is an AM-FM STEREO Tuner within the reach of every audiophile. Unmatched by units costing twice the price, the ST-11 is two distinct receivers in one featuring 4 μV. for 20 db quieting. Variable AFC. Single front panel switch controls AM, FM or STEREO selection.

Wired and tested $74.50 Easy-to-build Kit $49.95

ARKAY SPA-55
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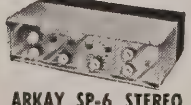
Two 27½ watt distortion-free hi-fi amplifiers for stereo. Or use as 55 watt monaural amplifier.

Easy-to-build Kit $64.95
Wired and tested $79.95



ARKAY SP-6 STEREO
CONTROL CENTER

Versatile stereo pre-amp with dual inputs and outputs. Hi-lo filters, reverse position, balance control. Less cover.

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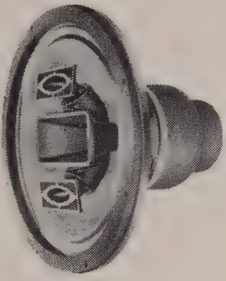
monophonic or as two separate inputs for each of two stereo channels. Four input jacks, located on the rear so as not to interfere with the operation of volume controls, accept two-conductor phone plugs; high-impedance circuits. Two phono jacks are provided for connections to the input of an amplifier or tape recorder. When used in the monophonic mode, the output jacks are common. No. 301 is the Model for monophonic mixing only.

Both units come in tan cabinets with recessed sloping front panels and brown knobs with "gold" metallic inserts. Rubber feet prevent scratching of a finished surface.

NEW GOODMANS SPEAKERS

Rockbar Corporation, Mamaronek, New York is handling the U. S. distribution of two *Goodmans* speakers—the "Tetraxiom" unitized 4-way system and the "Triaxiom" unitized 3-way system.



The "Tetraxioms" are 15" units featuring the "Rigidflex" cone, a completely flexible, free-floating cone rim, and completely rigid cone center to provide pure piston action. The speakers have high power capacity and smooth response from 20 to 20,000 cps with usable response to 35,000 cps. They are composed of four independent, concentrically placed radiators, each designed for maximum performance and efficiency within their portion of the spectrum.

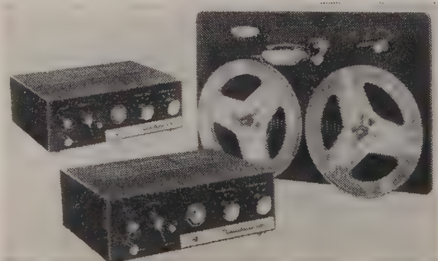
The "Triaxioms" give clean, undistorted response from 20 to 20,000 cps. They feature a plastic terminated, free-edge cone suspension with the low resonance "Rigidflex" bass diaphragm. This series comes in six models ranging in power handling capacity from 25 to 50 watts and in 12" and 15" sizes.

The U. S. distributor will supply additional details on either or both of these new models on request.

HEATH TAPE RECORDERS

Heath Company, Benton Harbor, Michigan is now offering three versions of its versatile tape recorder kit, the Model TR-1A.

Currently available are new half-track (Model TR-1AH) or quarter-track (Model TR-1AQ) versions which record and play back stereo and mono tapes as well as the original monophonic version (Model TR-1A) to which half-track or quarter-track stereo provisions may be added later using the MK-4 or MK-5 conversion kits.



The tape deck is extremely simple to assemble and uses precision bearings throughout. A single control lever selects all tape handling functions on the deck, greatly simplifying operation. Speeds of 7.5 or 3.75 ips are available. Flutter and wow are held to less than .35 per-cent. Each tape preamplifier features NAB (formerly NARTB) playback equalization, separate record and playback gain control, cathode-follower output, and provision for mike or line input.

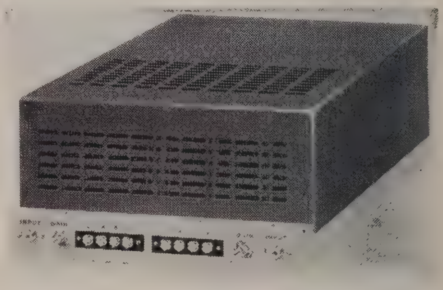
Recording level is indicated on a "magic-eye" tube. A safety interlock is provided to minimize accidental erasure of tape. Filament balance control allows adjustment for minimum hum level. Cathode-follower output from the playback channel is approximately 600 ohms impedance.

The unit comes with a vinyl-clad steel cover in black leather texture, templates, and instructions for panel mounting or equipment enclosure installation.

STROMBERG STEREO AMP

The *Stromberg-Carlson Division* of *General Dynamics Corporation* is now marketing a new stereo power amplifier which has been designated as the "Stereo 40."

This new power amplifier, Model ASP-422, is perfectly matched to the company's new stereo preamp (Model ASE-434). The single chassis carries two 20-watt channels of amplification and features a pair of 6DY7 dual beam-power pentodes. A variable input control and phantom output (mixed A and B) for three-channel operation are provided.



Frequency response is 20 to 50,000 cps ± 1 db. Harmonic distortion is less than 1% at full output with IM distortion less than 1% at program level. Hum and noise are 70 db down. A single input, variable from 1 to 10 volts, is provided.

For a data sheet on this and other items in the firm's stereo component line, write the Special Products Division of the company at 1400 N. Goodman St., Rochester 3, N. Y.

NON-WOVEN FELT

Troy Blanket Mills, 200 Madison Ave., New York 16, N. Y. has developed a new synthetic-fiber, non-woven felt which has been specifically designed for electronic and similar applications.

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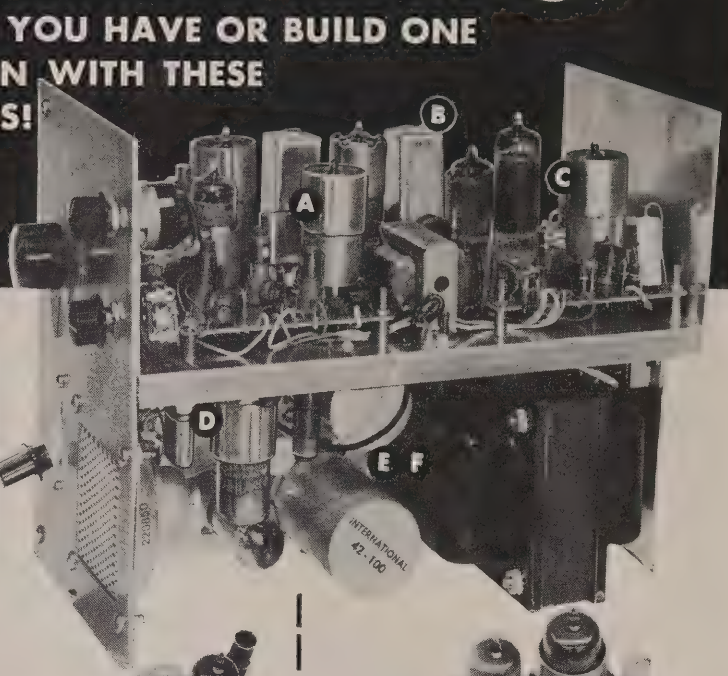
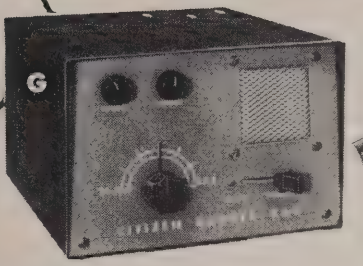
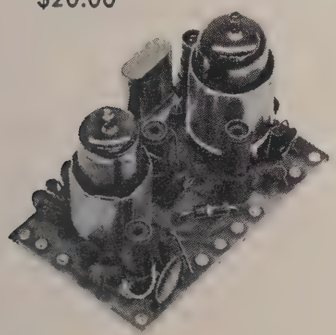
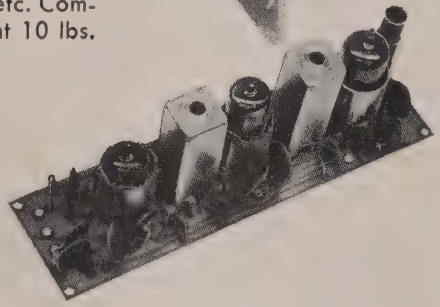




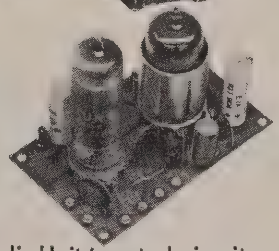
G Cabinet (all metal) includes hardware, switches, speakers, panel, case, etc. Complete instructions. Shipping weight 10 lbs. $20.00



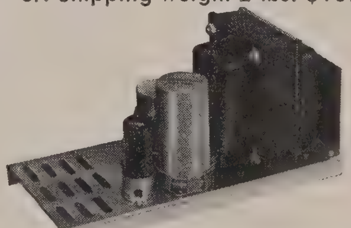
A RF Converter (printed circuit prewired), two-tubes, crystal controlled. Use with IF unit B. Shipping weight 2 lbs. $14.00.



B IF Unit (printed circuit prewired) consists of mixer and tunable local oscillator feeding 262 KC IF stage. Includes noise-limiter and squelch circuits. Designed to work with units A and C. Makes dual conversion receiver. Shipping weight 2 lbs. $16.00.

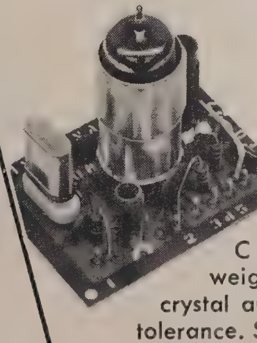


C Audio Unit (printed circuit prewired), speech amplifier for crystal or carbon microphone, first audio for receiver and power amplifier/modulator stage. Designed to follow unit B. Includes output transformer but not speaker. Shipping weight 2 lbs. $13.50



E Power Supply 115 VAC (not prewired). All parts necessary to construct power supply to operate Units A, B, C and D. Shipping weight 10 lbs. $12.00.

F Power Supply 3-way 6 VAC, 12 VDC or 115 VAC (not prewired). Shipping weight 10 lbs. $20.00.



D Transmitter Unit (prewired and tuned) Oscillator and amplifier. Crystal controlled. Requires Unit C for modulation. Shipping weight 2 lbs. Complete with crystal and tube certified .005% tolerance. $14.50.

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GOLD CROWN
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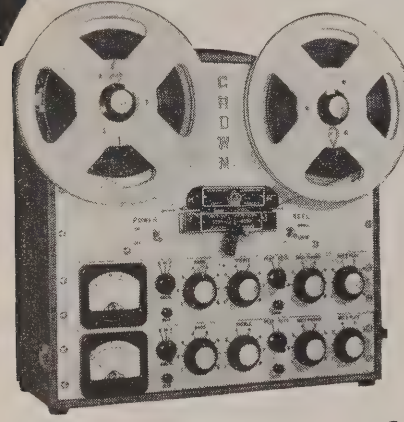
Records and plays Professional Stereo. Two or 4-track heads. All-aluminum construction



FREQUENCY RESPONSE	IPS SPEED	FLUTTER & WOW	NOISE RATIO
±2 db 30-30000 CPS	15	.06%	57 db
±2 db 20-20000 CPS	7½	.08%	54 db
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"Troyfelt" is available in a wide variety of widths and in a wide range of thicknesses, densities, and permeabilities. Since the material can resist abrasion, moisture, most acids and alkalis, and is uniformly smooth, the manufacturer suggests its application as a lining material for speaker cabinets, among other uses. It can be die-cut and will not become ragged at the edges.

The firm will supply additional information on request.

AUDIO CATALOGUES

"WHY A CERAMIC CARTRIDGE?"

CBS Electronics is offering a copy of new "Stereo-Talk" bulletin, which carries an informative article "Why a Ceramic Cartridge?", to interested audiophiles.

In the article the author, Bud Tomer, discusses factors important to the design of a high-quality stereophonic cartridge and compares magnetic and ceramic cartridges from the standpoint of linearity, output, hum, and shock resistance.

Designated as Bulletin E-325, a copy may be obtained free by writing the firm's Advertising Service, Parker St., Newburyport, Mass.

UNIVERSITY P.A. CATALOGUE

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. has issued a new product catalogue which carries full information, illustrations, and specifications on all of its new and current p.a. speakers and components.

Material in this new publication is grouped into several categories covering trumpets, paging and talk-back, submergence-proof speakers, hi-fi weatherproof dual-range systems, super-power projectors, portable soundcasting systems, and drivers and accessories. The last two pages of the catalogue contain hi-fi speakers and enclosures suitable for commercial installations.

SHURE CARTRIDGE DATA

Shure Brothers Incorporated, 222 Hartrey Ave., Evanston, Ill. has available two data sheets on its stereo phono cartridges which it will forward upon request.

One, two-color data sheet provides details on both the M3D "Professional Dynetic" and the M7D "Custom Dynetic" including price, tracking force, compliance data, response, etc. The second data sheet covers the M3D "Professional Dynetic" in considerable detail with information on mounting, stylus replacement, hooking up associated equipment, etc.

Either or both of these data sheets may be obtained by writing the manufacturer and indicating which information is required. —30—

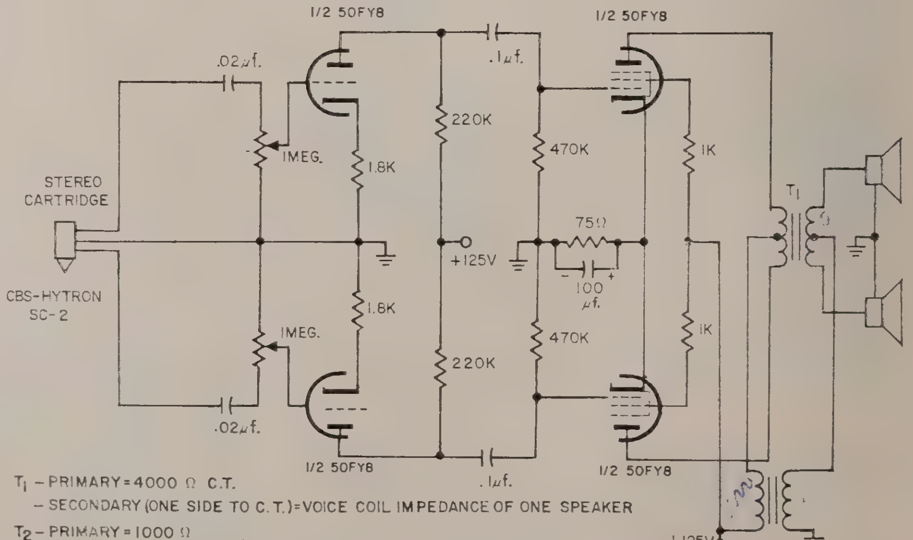
2-Tube 7-Watt Stereo Amplifier

A NEW miniature triode-pentode that makes possible very compact audio amplifiers, has just been introduced by CBS Electronics. The 50FY8 combines the voltage and power amplifiers in a single envelope. In addition to the 50-volt heater type, 25-, 12.6- and 6.3-volt heater types are also available as the 25FY8, 12FY8, and 6FY8, respectively. The tube features low plate and screen voltage requirements and provides 2.7 watts output in single-ended class A.

A pair of 50FY8's are the only tubes required in a stereo amplifier utilizing the CBS modified simplex circuit. Such an amplifier can provide up to 3.5 watts per channel. Complete construction details of an amplifier using two of these tubes, along with tone-control circuits and power supply, will appear in our September issue under the title "Compact Two-Tube Stereo Amplifier."

The technical bulletin E-334 describing the new audio tube is available from CBS Electronics Advertising Service, Parker St., Newburyport, Mass. —30—

Schematic diagram of the two-tube, seven-watt stereo amplifier using 50FY8's.



T_1 – PRIMARY = 4000 Ω C.T.
– SECONDARY (ONE SIDE TO C.T.) = VOICE COIL IMPEDANCE OF ONE SPEAKER
T_2 – PRIMARY = 1000 Ω
– SECONDARY = ½ VOICE COIL IMPEDANCE OF ONE SPEAKER

SSB Featured in New U. S. Official Jet

Sideband radio link allows world-wide communication.

FROM their new 600-mile-per-hour jet plane, top government officials will be in continual touch by radio with points anywhere in the world where there are communications facilities. The $5½-million plane, a *Boeing* VC137 and the first of three to be delivered for use of both military and civilian officials, was shown to the press recently.

Aboard the big four-engine jet is some of the most modern communications gear in the world. A key element is a revolutionary long-range communications system using single-sideband radio, the AN/ARC-65 system, developed by *Radio Corp. of America* and used in Strategic Air Command bombers for world-wide communications.

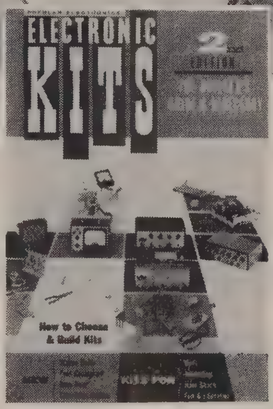
Incoming messages are reproduced by a teleprinter in the plane by means of a single-sideband converter. Conversely, the unit adapts outgoing teletypewriter messages for radio transmission. Message secrecy is maintained by use of supplementary equipment.

For all official messages, the executives aboard the plane will rely on the teletypewriter, although voice radio is also available when needed. The normal channel would be through the Pentagon communications center, which can "patch in" the exchange of messages with other communications facilities, including the Signal Corps teletypewriter network, the SAC network, the *Bell System* network, and *RCA Communications* for transmissions abroad. It can also be in direct contact with SAC bases both in the U. S. and abroad and with the North American Air Defense Command.

Because of its range and dependability, the SSB system will thus assure that government officials can be in touch at any time with the Pentagon, the White House, government offices, defense posts, foreign governments, and other offices throughout the world.

The jet plane, a military version of the *Boeing* 707, will be used mostly by Cabinet members and other high officials. The President will continue to use the "Columbine" as his personal plane, using the jet probably on rare occasions. It is interesting to note that the communications systems on most SAC bombers are now being converted from an earlier double-sideband system in use since 1953 to the new single-sideband system.

The plane also has installed an emergency-channel u.h.f. transmitter-receiver, a weather radar, and many other electronic navigational devices. A hi-fi tuner is even included for AM and FM radio broadcasts. —30—



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Because of the wide popularity of its first Annual on kit construction, Ziff-Davis now offers this exciting follow-up—the 2nd Edition of ELECTRONIC KITS! This brand-new sequel will save you money on hi-fi, ham radio, other electronics devices by showing you how to use easy-to-assemble kits! What's more, ELECTRONIC KITS—2nd Edition features a big up-to-date directory of available kits, complete with specifications, prices, and manufacturers' names!

Be sure to pick up ELECTRONIC KITS—2nd Edition at your newsstand—or send for a copy, using the handy coupon below. Only $1.00—it's a terrific buy!

Pick up your copy of the exciting new Electronic Kits —2nd Edition today at your Newsstand or Radio Parts Store—or order by mail, using handy coupon.

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Please send me a copy of the new ELECTRONIC KITS—2nd Edition. I enclose $1.00, the cost of this Annual, plus 10¢ to cover mailing and handling charges.

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The RCA Kit Parade

PRESENTS...

A new RCA-WV-77E(K) VoltOhmyst® for only $29.95*

Also available factory-wired and calibrated—RCA-WV-77E VOLTOHMYST—only $49.95*
*User Price (optional)

FREE—New Booklet, "Servicing Is Easy With An RCA VoltOhmyst" offered with the purchase of a WV-77E(K) or WV-77E ($1 value).

VoltOhmyst
RCA
VoltOhmyst WV-77E
ZERO ADJ.
OHMS ADJ.
AC VOLTS
DC VOLTS
OHMS
OFF
AC OHMS
DC
GROUND
RADIO CORPORATION OF AMERICA
CAMDEN NJ USA

Hams! Hobbyists! Service Technicians!—Here's the new RCA VoltOhmyst Kit you've been hearing about ...combining dependable electronic performance and ease of assembly!

Look what you get—ohms-divider network protected by fuse—ultra-slim probes and flexible leads for getting into those tight spots—leads, probes, and power cord can be stored in sleeve attached to handle for increased portability—separate scales for 1½ volts rms and 4 volts peak-to-peak maintain instrument accuracy on low ac measurements—all lettering on front panel acid-etched to last the life of the unit!

You can get the new RCA VTVM Kit at your local RCA Test Equipment Distributor today—it's available "off-the-shelf"! For literature, visit your nearest RCA Distributor, or write RCA Commercial Engineering, Section H-41-W-1 Harrison, N. J.

SPECIFICATIONS

Measures:

DC Volts—0.02 volt to 1500 volts in 7 overlapping ranges

AC Volts (RMS)—0.1 volt to 1500 volts in 7 overlapping ranges

AC Volts (peak-to-peak)—0.2 volt to 4000 volts in 7 overlapping ranges

Resistance—from 0.2 ohm to 1000 megohms in 7 overlapping ranges. Zero-center indication for discriminator alignment

Accuracy—±3% of full scale on dc ranges; ±5% of full scale on ac ranges

Frequency Response—flat within ±5%, from 40 cycles to 5 Mc on the 1.5, 5, and 15-volt rms ranges and the 4, 14 and 40-volt peak-to-peak ranges

DC Input Resistance—standard 11 megohms (1 megohm resistor in probe)

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

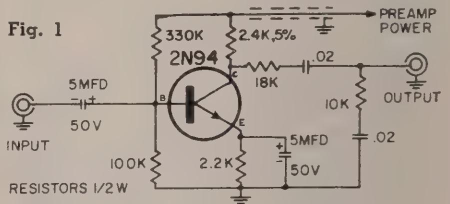
Service Notes

HOFFMAN: STEREO ADAPTER

To facilitate ready conversion of its monophonic audio systems for stereophonic use, this manufacturer furnishes stereo kit #ST-VRDP. Included is an *Audiogersh* "Stereotwin 200" cartridge, of the variable reluctance type, already mounted into a *Garrard* "Mark II" cartridge head. Owners of *Hoffman* systems using the "Mark II" changers simply have to plug in the new head, after conversion, for playing stereo discs, and may also use this cartridge for monophonic microgroove discs. The old head is still to be used for 78-rpm discs.

Since many of the second-channel amplifiers that can be added for a full stereo system do not include a preamplifier, required for the added channel of the low-level cartridge, the kit also includes transistor preamplifier #1131, shown in Fig. 1. The extra pair of signal leads from the stereo cartridge are simply plugged into the preamp "Input" and leads are connected from the "Output" of the preamp to the input of the new amplifier. The only problem is that of obtaining reduced, well-filtered "B+" to power the preamp, but this is not difficult. The lead labelled "Preamp Power" terminates in a phono-type plug, which may be inserted in a specially wired receptacle included in the kit. A 470,000-ohm, 2-watt resistor is in series with the green wire connected to the receptacle. This is the only connection that requires wiring into the circuit of the existing system. The other end of the resistor is simply wired and soldered to a d.c. voltage point in the amplifier chassis where from 150 to 250 volts or reasonably well filtered voltage is available.

Fig. 1



SPARTAN CHANGER: SKIPPING

If the stylus fails to track properly, in that it skips grooves or sticks in grooves on *Spartan-Collaro* record changers, stylus pressure may be incorrect. It should be checked with a gram scale—used as specified by the manufacturer of the scale—and adjusted to between 7 and 9 grams, if not already in that range. This is done by loosening both screws on the counterbalance adjustment plate and moving the plate back and forth until the proper weight is indicated on the scale. Then both screws should be retightened evenly.

If the problem persists with correct adjustment, other possible causes should be investigated. Check the stylus to see whether it is worn, bent, or clogged with foreign matter. Check to see whether the tone arm pivots freely. Sometimes its movement is restricted by improper dress or excessive tightness of the pickup leads. Make sure that the automatic trip lever is not bent and that it is free of burrs. If the changer is not properly level, this may also be a factor.

NATIONAL: SSB IMPROVEMENT

While the NC-109 receiver provides satisfactory SSB reception as originally designed, a simple improvement will eliminate the necessity of having to retune with varying r.f. gain control levels. Remove C_{16}, .01 μf., from the plate return of V_2 and reposition it across the two used terminals of r.f. gain control R_5. Change R_{11} from 150-000 ohms to 82,000 ohms. Remove R_{14} (470 ohms) and bring the red lead from it (plate return of V_2) back to "B+" (105 volts regulated). This is the orange wire near the rear of the chassis. Shunt a 20-μμf. fixed ceramic capacitor across C_{58} (47 μμf.). Change R_4 from 68 to 120 ohms. Change C_{28} from .047 μf. to .22 μf.

WESTINGHOUSE: RADIO AUDIO

Distorted sound output in portable radios H-557/8/9 and H-600P4 may occur under rather puzzling circumstances: it will be evident on a.c. operation only while the "A" battery is in the receiver. If the "A" battery is removed, the symptom is no longer evident on a.c. operation. The distortion usually occurs about 5 minutes after operation and disappears several minutes later. The cause is a.c. leakage through filament-dropping resistor R_{14} (see Fig. 2A) to chassis ground. To eliminate the condition, add a 220,000-ohm, ½-watt resistor in shunt with capacitor C_6, .047 μf. Physical and electrical locations of the component to be added are shown in Fig. 2A (chassis out of cabinet) and Fig. 2B respectively. —30—

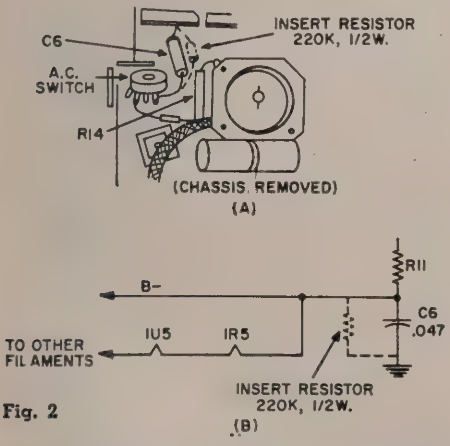


Fig. 2

The RCA Kit Parade

PRESENTS...

A New RCA Volt-Ohm-Milliammeter

...special ranges for transistor servicing!

RCA WV-38A(K) VOM Kit
ONLY $29.95* (includes internal batteries, probe and cable with slip-on alligator clip, ground lead and clip, assembly and operating instruction booklets)
*User Price (Optional)

RCA WV-38A VOM
ONLY $43.95* completely wired and calibrated

EXCLUSIVE! Extra 1-volt and 0.25-volt (250 mv) ranges permit wide applications in transistor servicing!

EXCLUSIVE! New handle clips accommodate probes and test leads for extra carrying convenience!

EASY ASSEMBLY...
★ mount six components on the front panel
★ mount all other components on one side of laminated circuit board
★ put panel and circuit board together
★ slip on the knobs!

Never so many valuable features packed into a VOM!—Ohms-divider network fuse-protected. Easier-to-read scales! Extra-large 5¼-inch meter. Polarity reversal switch. Improved frequency response. Full-wave bridge rectifier. Less circuit loading. Standard dbm ranges. PLUS—modern styling—it's an instrument you'll be proud to "show off!"

WV-38A SPECIFICATIONS

Input Resistance	• 20,000 ohms per volt on DC 5,000 ohms per volt on AC
Accuracy	• ± 3% DC, ±5% AC (full scale)
Regular Scales	• 2.5, 10, 50, 250, 1000, 5000 volts, AC and DC • 50 μa, 1, 10, 100, 500 ma, 10 amps (DC)
Extra Scales	• 250 mv. and 1 volt (dc)
Frequency Response	• AC—flat from 10 cycles to 50 Kc (usable response at 500 Kc)
Ohms	• 3 ranges: Rx1—(0-2,000 ohms), Rx100 (0-200,000 ohms), Rx10,000 (0-20,000,000 ohms)
Dimensions	• W. 5¼", H 6⅞", D 3⅛"

See it at your local RCA Test Equipment Distributor!

RCA
RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

Problems in AM Reception

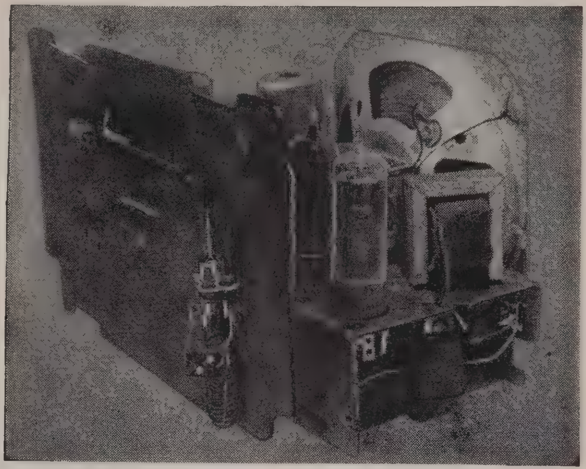


Fig. 1. Adding a variable ferrite-core antenna, tuned to absorb interference.

By **J. RICHARD JOHNSON**

When distortion, interference, unstable performance, and other annoying effects kill off the program, don't be quite so quick to blame it all on the receiver. Many of these are caused by outside factors.

WHEN A RADIO receiver is noisy, it isn't always its own fault. When squeaks, squawks, whistles, and other irritating sounds interrupt a favorite program, the first and obvious reaction of the set owner is to condemn the instrument. If you happen to be a technician to whom he has brought his problem, all he knows is that he wants you to "fix the set." He is not the least bit interested in the vagaries of propagation, cross-modulation, and harmonic generation.

Of course, since such troubles originate outside the receiver, you just *can't* fix the set. There is nothing wrong to fix. The problem then is the delicate one of explaining things to the customer. If you happen to be in a position to sell or profitably install other equipment, the explanation need not be without its rewards. Most of the unfortunate effects originating outside the receiver are characteristic of AM broadcast reception alone. This produces the opportunity to sell or install FM, for example. In any case, retaining the customer's confidence by being able to explain to him just what is wrong, when a remedy cannot be applied, is important. With this in mind, let's review some of the more common "external" problems in AM reception.

Transmitter Harmonics

In an earlier era, the harmonics radiated by broadcast stations used to be quite troublesome. For example, let us suppose that a station assigned to 700 kc. is radiating considerable second-harmonic energy. This can be heard when the radio is tuned to 1400 kc. If another, desired station is assigned to 1400 kc. (or very near it), interference results. These days the Federal Communications Commission is so strict about harmonic attenuation at the transmitter that you seldom run into this trouble. However, if you happen to be fairly close to a given transmitter, even second harmonics well below the legal maximum can show up.

Because these harmonics are generated at the transmitter, there is little that can be done at the set if these signals cause interference because they happen to coincide exactly with the fundamental of another desired station. However, it will be more likely that the interfering harmonic radiation occurs *near* the frequency of the desired signal rather than exactly on it. In the latter event, there is a good chance that a wavetrap can be constructed to remedy the situation.

Before the advent of loop antennas, it was not unusual to install a wavetrap—a circuit tuned to reject the interfering signal—in series with the antenna lead. It would still be possible to insert such a trap in series with the hot lead to the loop antenna, but its presence might upset receiver tracking. More convenient traps are shown in Figs. 1 and 2.

One of these traps (Fig. 2) is made by mounting an extra antenna loop similar to the original to the back of the receiver so that it is physically near the original antenna, although no direct connection is made. A trimmer capacitor, as shown, is connected across the loop, and the combination is tuned to the interfering station's harmonic. Value of the trimmer is determined experimentally. The principle involved is the same as that used in the absorption traps found in the video i.f. sections of many TV receivers.

Even easier than adding the extra loop, in many cases, is incorporation of one of the ferrite-core antennas, such as the "Loopsticks." Such a unit can be mounted directly on the back of the receiver's loop, as shown in Fig. 1. In this case, a fixed capacitor (220 $\mu\mu$fd. is a good value to start out with) is connected across the coil and the slug of the antenna rod is varied for exact tuning. The combination shown can be adjusted from the low end of the band to about 900 kc. Higher frequencies can be obtained by reducing the value of the shunt capacitor.

In the case of either the added loop or the added ferrite-core rod, coupling depends on how much of the field of the new unit overlaps the field of the original. Close coupling will provide more attenuation of the undesired signal, but will also provide some attenuation over a broader range of frequencies. The latter could also reduce the wanted broadcast. Experimentation will determine the best position.

Before leaving the matter of harmonics, we should note that they can also be generated in the receiver in some nonlinear circuit element. This possibility is worth checking prior to any attempt at external suppression. A defective tube or other component could be responsible or the cause could be overload if the offending signal is strong. As a rule, if there is no receiver defect, a.v.c. action should prevent overload in all but some few extreme cases.

Co-Channel Interference

On some AM broadcast channels, you can hear more than one station at a time, especially at night. When this occurs, the two carriers heterodyne or beat with one another, and the difference-frequency beat is normally audible. Since AM stations are required to hold within 20 cps of their assigned frequencies, the greatest difference frequency you should be able to hear between two "same channel" stations is 40 cps. Ordinarily this heterodyne is only a few cycles per second and shows up as a pulsating effect. However, you may be getting a signal from outside this country where the deviation is more than 20 cps or where the assignment is at an odd frequency. In such cases, the heterodyne is heard as a higher, more definite tone.

Since nothing at all can be done at the receiver to eliminate this beat phenomenon, except possibly to reorient the antenna to pick up the desired signal while discriminating against the interfering one, a careful explanation of what is going on is the only action possible.

This annoyance results from the overlap of signal-coverage areas on the part of the two (sometimes more) stations operating on the same frequency. Neither station is close enough to the receiver location to "swamp out" the signals of the other. Keep in mind that the frequency, power, antenna radiation patterns, and hours of operation of these stations have been assigned according to a carefully worked-out plan by the FCC. The intent of the plan is to allow the greatest number of stations to be on the air with a minimum of mutual interference.

Local stations, within whose *intended* service area you are located, are not expected to suffer from such interference. Those channels on which two or more stations come in with approximately the same strength *are not expected to be useful in the area where this condition occurs.* Ordinarily, when this problem is encountered, the sky waves of the two stations are involved, while the ground waves are providing good, clear reception in their stations' intended areas of coverage. More will be said about these waves later.

If you check your strong, local stations on the dial—and you can demonstrate this to a dubious set owner—you will notice that the ones you are supposed to be receiving are at least 40 kc. apart. Some stations, so located that they may interfere with each other at night when the transmission range increases, are required to "share time." This explains why some of them are limited to daytime operation only. In other cases, one or both such stations are required to use transmitting antennas whose directivity is such that their signals are aimed away from each other. From these demonstrable facts, it can be seen that co-channel interference is not properly a receiver trouble.

Selective Fading

As a result of the simultaneous existence of the ground waves and sky waves already mentioned, selective fading can occur anywhere on any broadcast receiver. The symptom is usually that of a severe garbling or "scratchiness" of the audio, frequently without much apparent change in amplitude of the signal. It is important to recognize because it may be confused rather easily with other troubles that may originate inside the receiver.

Note in Fig. 3 that direct transmission to cover a local service area extends roughly to the horizon. This area is the ground-wave range. However some of the transmitted energy radiates up to the ionosphere, from where it reflects back to earth in the form of sky waves. In selective fading, a transmission interferes with itself, as it were. That is, the ground-wave components, at the fringe of the local service area where this wave is beginning to die out, are received along with some sky-wave components.

The difficulty here is that these two types of waves, travelling over propagation paths of different lengths, differ in phase when they reach the receiver. This is comparable to ghost signals in TV reception. What's more, this phase difference does not remain constant. For example, it may vary so much with frequency that one set of sidebands of the signal may shift phase more than the other set. The result is distortion. Add to this the fact that the ionosphere, from which the sky wave is reflected, constantly varies in such characteristics as altitude, so that the nature of the fading is always changing.

Close to the transmitter, in the local service area where the ground wave predominates, selective fading is not normally encountered. Ironically enough, this problem is not usually severe at much greater distances (say, over 200 miles away). This is so because, so far away, the ground wave is no longer present to complicate matters; thus, the only fading noted will be due to ionospheric variations and their direct effect on the sky waves. However, that unfortunate twilight zone, shown as the overlapping "selective fade area" in Fig. 3, suffers most. Both signals can come in over this region, which extends roughly 35 to 150 miles from the transmitter, depending on such variables as earth conductivity, antenna height, and operating frequency.

The main problem with this phenomenon is identifying it since, as already noted, it often sounds like other distortions due to receiver defects. Experience develops the ability to recognize the effect and distinguish it from others, but the set owner may not be in a position to spot this difference. The easiest and most convincing check is to tune in other stations whose transmitters are closer and to note whether similar distortion is experienced.

External Mixing

Often radio listeners complain that two stations come in on the same channel on an AM broadcast receiver, even though one of these stations is not assigned the channel to which the receiver is tuned. One of the most common causes of this is what we may call "external mixing." The signals of two powerful local stations are picked up by some metallic object in the vicinity of the receiver. The metallic object has a nonlinear impedance to ground, as does a diode or other vacuum tube. This is exactly the same characteristic which the receiver's converter employs to mix the local-oscillator and incoming signals to produce the i.f. difference signal. However, in this case, it is the two strong broadcast-station signals that mix, producing sum- and difference-frequency signals. If one of the sum or difference signals falls on the channel to which the receiver is tuned, interference results. Let's consider some examples:

1. A signal on 570 kc. (to which the receiver is tuned) and another strong local signal on 1140 kc. mix in a nonlinear circuit external to the receiver. The difference beat, at a frequency of 1140 − 570 = 570 kc., interferes with the desired 570-kc. signal.
2. Strong local signals, one on 660 kc. and the other on 770 kc., mix to produce a sum beat at 1430 kc. (660 + 770). This beat signal interferes with another desired station signal being received at or near 1430 kc.

One very common nonlinear element in which such mixing can take place is overhead wiring with a poor r.f. ground. Occasionally a ground wire on a telephone pole becomes a little loose or corroded and develops a sufficiently variable impedance to cause trouble. Sometimes, while listening to a car radio, you can hear a "burst" of this kind of interference when passing such a ground connection.

The solution to a problem of this kind is to repair the circuit in which the mixing is taking place. Thus, in the case of the example above, the ground connection must be fixed. Power and telephone companies are usually very cooperative in this—providing you can demonstrate this is the trouble. Sometimes the cause may be more obscure, arising in such things as house plumbing, loose rain gutters and downspouts, and lightning rods. Naturally, nothing can be done at the receiver, since the interference has already been developed by the time the signals reach the set. —30—

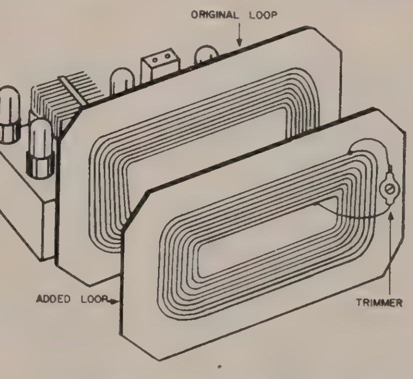
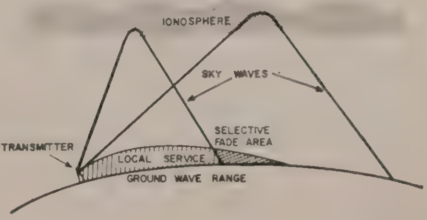


Fig. 2. Added loop antenna with tuning trimmer to act as absorption trap.

Fig. 3. Paths of ground and sky waves.



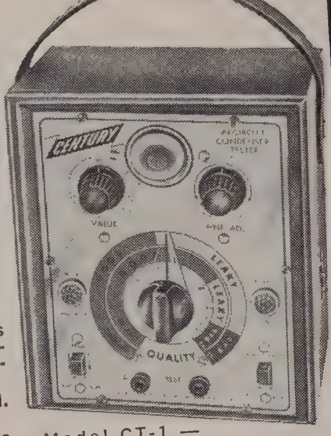
SHIPPED ON APPROVAL

IN-CIRCUIT CONDENSER TESTER

Model CT-1

AN ABSOLUTE 'MUST' FOR EVERY SERVICEMAN!

Here is an in-circuit condenser tester that does the whole job. The CT-1 actually steps in and takes over where all other in-circuit condenser testers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation. . . .



Model CT-1 — housed in sturdy hammertone finish steel case complete with test leads **$34⁵⁰ Net**

SIZE: W-6" H-7" D-3¼"

in-circuit checks:

- ✓ Quality of over 80% of all condensers even with circuit shunt resistance present . . . (leakage, shorts, opens, intermittents)
- ✓ Value of all condensers from 200 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- ✓ Quality of 100% of all condensers . . . (leakage, shorts, opens and intermittents)
- ✓ Value of all condensers from 50 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ High resistance leakage up to 300 megohms
- ✓ New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

SPECIFICATIONS

• Ultra-sensitive 2 tube drift-free circuitry • Multi-color direct scale precision readings for both quality and value . . . (in-circuit or out of circuit) • Simultaneous readings of circuit capacity and circuit resistance • Built-in hi-leakage indicator sensitive to over 300 megohms • Cannot damage circuit components • Electronic eye balance indicator for even greater accuracy • Isolated power line

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A Real *ECONOMY* MULTIPLE SOCKET TUBE TESTER without sacrifice in *ACCURACY, SPEED* or *VERSATILITY*

Here is a multiple socket tube tester designed to meet limited budgets. Although low in price it boasts a unique circuitry that enables you to check over 600 tube types — and has a range of operation that far exceeds others in its price class.

Model MC-1 — housed in sturdy wrinkle finish steel case **$39⁵⁰ Net**

**SIZE: W-9"
H-8½"
D-2¾"**

SPECIFICATIONS

• Checks emission, inter-element shorts and leakage of over 600 tube types. This covers OZ4s, series-string TV tubes, gas regulators, auto 12 plate volt, hi-fi and foreign tubes • 3 settings enable a test of any tube in less than 10 seconds • Employs dynamic cathode emission test principles • 3½" D'Arsonval type meter — most accurate type available . . . its greater sensitivity means more accuracy . . . its jewel bearing means longer life • 17 long lasting phosphor bronze tube sockets • Combination gas and short jewel indicator • 9 filament positions • Handy tube chart contained in special back compartment • New tube listings furnished periodically at no cost • Detachable line cord

plus these BONUS FEATURES . . . found in no other low price tube tester

✓ Checks for cathode to heater shorts ✓ Checks for gas content ✓ Checks all sections of multiple purpose tubes . . . will pickup tubes with one "Bad" section ✓ Line isolated — no shock hazard ✓ Variable load control enables you to get accurate results on all tubes ✓ Positively cannot become obsolete as new tubes are introduced.

IN-CIRCUIT RECTIFIER TESTER

Model SRT-1

Checks all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc.

With the growing trend towards compactness, portability and low price, TV manufacturers are resorting more and more to producing series-string TV sets employing selenium, germanium or silicon power rectifiers. Now the need for an in-circuit rectifier tester is greater than ever.

THE SRT-1 CHECKS ALL POWER RECTIFIERS IN-CIRCUIT AND OUT-OF CIRCUIT WITH 100% EFFECTIVENESS FOR:

✓ Quality ✓ Fading ✓ Shorts ✓ Opens ✓ Arcing ✓ Life Expectancy

Model SRT-1—housed in sturdy hammertone finish steel case complete with test leads **$29⁵⁰ Net**

SIZE: W-6" H-7" D-3¼"

SPECIFICATIONS

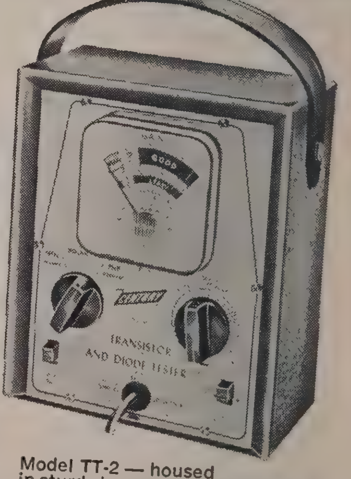
- Checks all types of power rectifiers rated from 10 ma. to 500 ma. (selenium, germanium, silicon, etc.) both in-circuit or out-of-circuit.
- Will not blow fuses even when connected to a dead short.
- Large 3" highly accurate multi-color meter . . . sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests.
- Cannot damage or over heat rectifier being tested.

SIMPLE TO OPERATE Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales. . . .

TRANSISTOR TESTER

Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY



Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors can develop excessive leakage, poor gain, shorts or opens, the need for TRANSISTOR TESTER is great.

Model TT-2 — housed in sturdy hammertone finish steel case complete with test leads **$24⁵⁰ Net**

SIZE: W-6" H-7" D-3¼"

SPECIFICATIONS

• Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current • Checks all diodes for forward to reverse current gain • All tests can be made even if manufacturers' rated gain is not available • Less than half a minute required for tests of either transistors or diodes • Large 3" meter is extremely sensitive yet rugged . . . with multi-color scales designed for quick easy readings • Power is supplied by an easy to replace 6-volt battery — current drain so small, service life almost equal to shelf life. Battery cannot be drained due to accidental shorting of test leads • Cannot burn-out its own meter or damage transistor or diode under test • Long test leads and insulated test clips enable tests without entirely removing transistor from circuit • Test leads are identified by E.I.A. color code so that connection to the correct terminal is assured • Comes complete with replaceable transistor set-up chart that fits into a special rear compartment.

IMPORTANT FEATURE: The TT-2 cannot become obsolete as the circuitry is engineered to enable you to check all new type transistors as they are introduced. New listings will be furnished periodically at no cost.

EASY TO BUY IF SATISFIED
see order form on facing page

FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER

Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new *MULTI-PROBE* * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

① DC Probe ② AC-Ohms Probe ③ Lo-Cap Probe ④ RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

SIZE:
W-7⅜"
H-9"
D-4¼"

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

OUTSTANDING FEATURES

• Completely portable — self powered with long life batteries — permits use everywhere • New advanced pentode amplifier circuit assures amazingly low battery drain • Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s • Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC • Simplified multi-color easy-to-read 4-scale meter • No heat operation assures rigid stability and accuracy • Immune to power line fluctuations • Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments • Meter completely isolated — practically burn-out proof • Hand-crafted circuitry eliminates the service headaches of printed circuitry • 1% resistors used for permanent accuracy • Separate RF ground return for low-loss RF measurement • Microphone type co-axial connector • Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- **DC Volts** — 0 to 1.5/6/30/150 300 600/1500 volts
- **AC Volts (RMS and Peak-to-Peak)** — 0 to 3/12 60 300 1200 volts
- **Ohms** — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- **RF** — Peak reading demodulator supplied for use on all DC ranges
- **Zero Center** — available on all DC volt ranges with zero at mid-scale
- **Decibels** — from —10 Db to +10, 22/36/50, 62 based on the Dbm unit: ODb-IMW in 600 ohms
- **Impedance** — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- **Input Capacity** — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

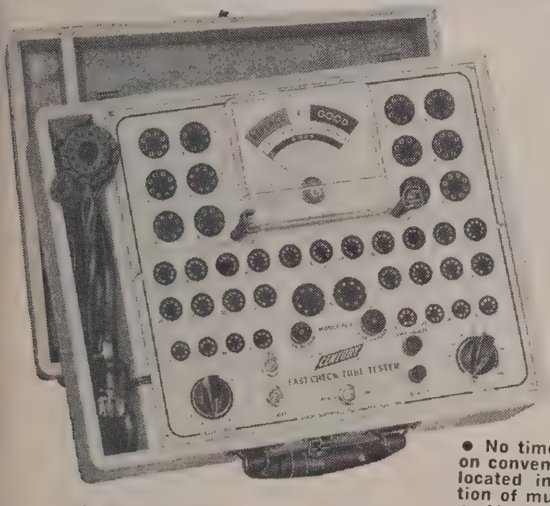
Model VT-1 — fully wired and calibrated, housed in handsome hammertone finish steel case, complete with MULTI-PROBE and thorough instruction manual covering all the applications in detail.

$58.50 Net

FAST-CHECK TUBE TESTER

Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!



SIZE: W–14⅝" H–11¼" D–4⅜"

Model FC-2 — housed in hand-rubbed oak carrying case complete with CRT adapter

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Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- ✓ Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

SPECIFICATIONS

• No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers • No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement • Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale • 41 phosphor bronze beryllium tube sockets never need replacement • 7-pin and 9-pin straighteners mounted on panel • Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out • Special scale on meter for low current tubes • Compensation for line voltage variation • 12 filament positions • Separate gas and short jewel indicators • Line isolated — no shock hazards • Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

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ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying direct from the manufacturer.

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  $4.50 within 10 days. Balance $5 monthly for 5 months.
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- ☐ Model VT-1 Battery Vacuum Tube Volt Meter $58.50
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  $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

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Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

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Please print clearly

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City .... State ....

SPECIAL SALE

1½" SQUARE METER. 0-100 Microamps—Perfect for "S" Meter, Grid Dippers, etc. American Mfr. LOW PRICE......ea. $3.45
5 for $15.00

BRAND NEW MOBILE DYNAMOTORS

MADE BY EICOR—SMALL SIZE
Input 12 Volts. Output 400V. 180Ma Cont. Duty. 250 Mil. Int. Duty........ $4.95
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POWER TRANSFORMER

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Pri. 115V. Secs. 320-0-320V. @ 150 Ma. 5V. @ 2 Amps 6.3V. @ 3 Amps... $2.95
Write for quantity prices

FILAMENT TRANSFORMERS

Prim. 115V. 60 cy. Sec. 6.3V. @ 20 Amps. H-4½" x W-4" x D-3½"....ea. $3.50
Primary 110V. 60 cy. Sec. 5V. @ 10 Amps. Ins. 10,000 V. Small size. 2 for $7.50..................Each $3.95
Primary 110 volts 60 cycle. Secondary 2½ V. 10 Amps. 10,000 V. Insulation. Suitable for pair of 866 tubes........ $3.95
Pri. 115 V 60Cy Sec. 6.3 1 amp ....ea. $1.19
12 Volt 1 amp $1.19
24 Volt 1 amp $1.19
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CHOKE—FULLY CASED

5 HENRY @ 200 Ma	1.95
5 HENRY @ 250 Ma	2.25
12 HENRY 500 Mil	8.95
4 HENRY 900 Mil	12.95
6 HENRY 600 Mil	8.95

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3 MFD	600 VDC	.60
4 MFD	600 VDC	.75
5 MFD	600 VDC	.80
6 MFD	600 VDC	.85
8 MFD	600 VDC	.95
10 MFD	600 VDC	1.19
12 MFD	600 VDC	1.50
3x8 (24 MFD)	600 VDC.....	2.50
1 MFD	1000 VDC	.60
2 MFD	1000 VDC	.85
4 MFD	1000 VDC	1.35
8 MFD	1000 VDC	1.95
10 MFD	1000 VDC	2.50
12 MFD	1000 VDC	2.95
15 MFD	1000 VDC	3.50
1 MFD	1200 VDC	.45
1 MFD	1000 VDC	.75
2 MFD	1500 VDC	1.10
4 MFD	1500 VDC	1.95
1 MFD	2000 VDC	.85
2 MFD	2000 VDC	1.50
4 MFD	2000 VDC	3.50
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110V. 60 cyc. .3 Amp. 1600 Rpm. 3¾" Blower wheel—Outlet 2" Diameter..ea. $7.95
2 for $15.00

SIGMA 5F RELAY

16,000 ohm in dual 8,000 ohm coils. SPDT adjustable silver contacts and armature tension. Operates on 500 Microamperes or less ....Ea. $3.95
Write for quantity prices

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Allied 110V. AC 4PDT 10 amp contacts ....ea. $2.50
Hermetically Sealed Relay Coil 110V AC 60 cy SPDT Contacts 5 Amps.......ea. $1.50
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LEACH ANT. RELAY 110V. AC DPDT Ceramic Ins................ea $3.45

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Calib. S1-S9 to 50 db above. Each $3.95

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0-1 Mil	2.95

2" METERS

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18-36 Volts DC	1.99
0-150 V. AC	3.49
0-3 Amps RF	2.95

3" METERS

0-10 Mil DC	3.95
0-50 Mil DC	3.95
0-100 Mil DC	3.95
0-150 Mil DC	3.95
0-12 Volts AC	3.95
0-15 Volts AC	3.95
0-800 Volts DC	4.50
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MISCELLANEOUS SPECIALS

SPERTI VACUUM SWITCH.-CYS24163 Replacement in Antenna Unit ART13. NEW, BOXED ....ea. $1.95
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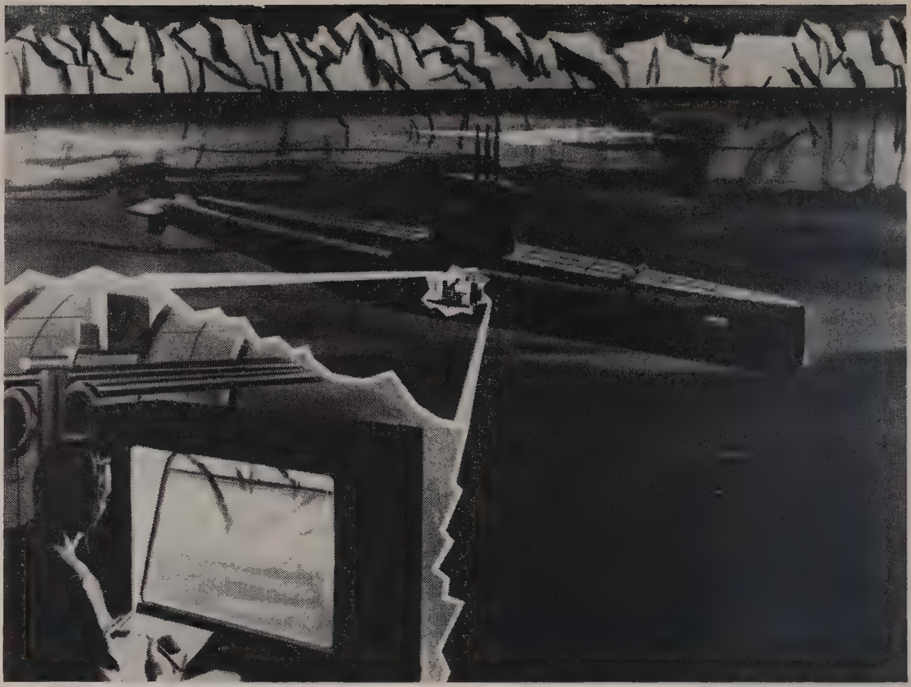


Installation on nuclear submarine "Skate" helped locate openings in the ice.

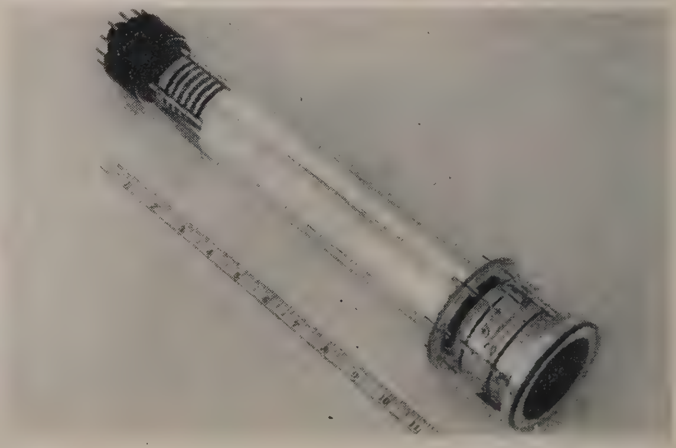
Super-Sensitive TV Camera Tube

New tube literally sees in the dark without any special illumination—such as infrared.

A SUPER-SENSITIVE electronic "eye" developed by *General Electric Co.* helped the nuclear submarine "Skate" probe a path under the Arctic ice and surface exactly at the North Pole. The "eye" is a TV camera tube known as a low-light-level image orthicon which can literally see in the dark. The new tube is up to 100 times more sensitive than other tubes of its type when used with special cameras. Recent tests conducted by Army researchers developing night surveillance equipment showed the tube could receive useful pictures of vehicles 750 yards away in the middle of the night using only the light reflected off the clouds from a city 20 miles away. The tube does not require any special illumination—such as infrared—to operate. Key to the tube's sensitivity is a special film target which permits operation over a range from full sunlight to almost pitch darkness.

In its application on the "Skate," the tube was used in a special, compact camera designed by *Bendix Aviation Corp.* The camera was mounted in a shockproof enclosure on the vessel's forward deck and transmitted pictures to a monitor in the sub's attack center. The camera permitted the submerged crew to view the dark underside of the polar ice cap and helped them locate "lakes" where newly formed ice was thin and the "Skate" could surface. The sensitive tube spotted faint patches of light in the dark ice.

Now being widely tested by the Army and the Air Force for military applications, the new tube is also expected to be applicable in various industrial closed-circuit television systems. —30—



The new tube is identical to standard broadcast orthicons with respect to size, configuration, and socket connections, and can be used in existing equipment without changes. However, the tube is up to 100 times more sensitive when used in a special TV camera.

NEW 8-TRANSISTOR!

REALISTIC PORTABLE ROCKS RADIO INDUSTRY

REALISTIC
8 - TRANSISTORS
REALISTIC

FEATURES:

- ★ It's a radio!
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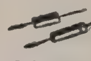
- ★ Amplified automatic gain control!

8 TRANSISTORS!


2 DIODES!

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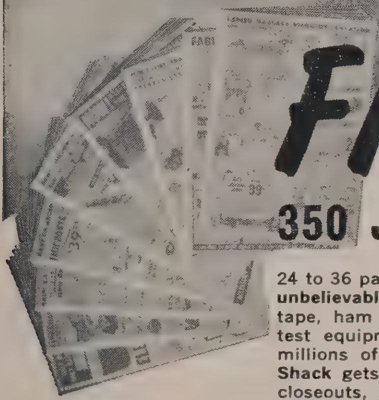
BATTERY INCLUDED FREE!

$29.95

$5 DOWN, $5 MONTHLY



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35¢ CAN SAVE YOU $100's

Radio Shack's new 1960 catalog, GUIDE TO ELECTRONIC BUYING creates a **new standard** in electronic catalogs. It's big . . . 8½" x 11", has over 250 pages, lists lowest net prices on everything electronic, contains up-to-the-minute feature articles, engineering charts and data prepared by **leading authorities**, is profusely illustrated with **big clear pictures** and is handsomely printed in rotogravure. Ready in September.

- Articles!
- Big Pages!
- Big Pictures!
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- Tables!

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OBSOLETES ALL OTHERS

A fantastic 8-Transistor portable with the selectivity, sensitivity and tone you'd expect from a $70 or $80 portable — at less than half the price. AND look at the extras. The Realistic-8 can be used for a paging system (with an optional mike), as a phono amplifier, or you can use it for "private" listening with an optional earphone. It is only 6½" x 3$\frac{9}{16}$" x 1¾" and weighs less than 1½ pounds, including battery. The built-in ferrite core antenna pulls in far-distant stations. It has an output jack for earphone or extra speaker and an input jack for phono cartridge or mike! Check all the features and "specs" — **THEN CHECK THE PRICE!**

ADDITIONAL BATTERIES (1 included)	$ .59
MAGNETIC EARPHONE FOR REALISTIC-8	.98
"SILVER DOLLAR" SIZE CRYSTAL LAPEL MIKE	2.85

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TRANSCEIVER
27 MC TWO-WAY
- Maximum Distance
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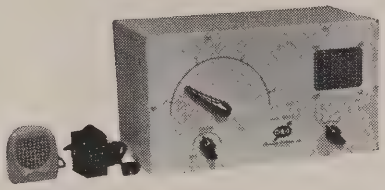

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All units will operate on 6V DC, 12V DC or 117V AC merely by connecting proper wire to primary in the power plug.

KIT FORM—MODEL 1000 DK
All parts and easy-to-follow instructions $79^{95}

FACTORY WIRED & TESTED
Ready for immediate use............... $99^{95}

Prices cover unit complete with mike. A FULL SUPER HET UNIT WITH RF AMP. Receiver can be tuned to all 22 channels plus 10 meter band.

NEW: Custom Dispatcher Crystal Controlled Receiver $129^{95}

Simple To Operate
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Meets or Exceeds All
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Kits may now be purchased from your local parts distributor. If your distributor does not have these kits in stock, contact us directly.

Prices F.O.B. Chickasha. Send 15% deposit on C.O.D. orders.

CHICKASHA
ELECTRONICS
INC.
P. O. Box 702
Chickasha, Oklahoma

Phono Preamp for Stereo

(*Continued from page* 63)

Feedback equalization was restored and RIAA equalization measured. Fig. 6 shows that the characteristic follows RIAA to better than a decibel. Signal-to-noise ratio with equalization is 70 db and total distortion is less than 0.7% including harmonic and intermodulation terms.

Construction

Construction of the preamplifier is straightforward and non-critical. Any type of construction can be used successfully, but it is wise to keep lead lengths short and vital that the preamplifier be totally enclosed in a metal case to shield it from hum fields.

Power for the preamplifier can be obtained either from a battery or a separate negative power supply. A 22½-volt battery is preferable for minimum hum and should last for about six months under continuous use. However, the alternate power supply shown in Fig. 3 can be used as well. This power supply can be built for about $7 and yields a signal-to-hum ratio of over 70 db. The value of power supply resistor R_{20} depends on whether or not a booster is to be used and powered by the power supply. If a booster is *not* used, R_{20} should be a 27,000-ohm, ½-watt resistor. If a booster *is* used, R_{20} should be omitted.

Values of the electrolytics are not critical. If you cannot obtain a listed value, substitute a larger capacitance with the same or higher voltage rating.

If a booster is used, it may be built as part of the preamplifier proper or on a separate chassis. The shielded leads from the booster to the main amplifiers or control center should be kept short in order to prevent high-frequency attenuation by the cable since the output impedance of the booster is considerably higher than that of the preamplifier.

The primary source of noise in the preamplifier is due to thermal noise in the loading resistors. Therefore, be sure to use low-noise deposited carbon types for R_1, R_2, R_9 and R_{10} as well as for the collector resistors R_8 and R_{11}.

A double-shielded cable is recommended for connecting the cartridge to the preamp. However, double-shielded cable may be difficult to obtain. A simple solution is to use conventional shielded cable, sliding copper braiding over the cable to form the second, grounding shield. Cable capacitances of up to 500 $\mu\mu$f. can be tolerated without any affect on the performance.

No adjustments are necessary in the preamplifier, but the perfectionist may wish to trim the RIAA equalization to follow the RIAA curve exactly. This adjustment is not essential because the RIAA curve will be followed within a decibel with the nominal components listed. Confidentially, the author trimmed the values in his unit just to make *sure.*

If you wish to adjust the preamp to follow the RIAA curve exactly, proceed as follows: Set an input generator to 1000 cps and adjust its amplitude so that the preamp output is .1 volt. Set the generator to 500 cycles and trim C_4 (and C_{10}) so that the output rises 3 db above the 1000-cps level (1.41 volt). Set the generator to 2120 cycles and trim C_8 (and C_9) so that the output drops 3 db below the 1000-cps level (.707 volt). The preamplifier is now adjusted to the RIAA characteristic.

—30—

Evaluating a Scope

(*Continued from page* 67)

plifier. Therefore, it is not normally necessary to have a wide-band response in this amplifier. Some scopes use the same type of amplifier for both vertical and horizontal channels, but this is quite unnecessary. A horizontal amplifier with a frequency response that is fairly flat up to 500 kc. is adequate for TV service work. Since the sweep generator is used in conjunction with the horizontal amplifier to sweep the beam across the screen of the CRT, this amplifier should have a range between 15 and 500,000 cps and the saw-tooth linearity should be good. If the saw-tooth is curved as shown in Fig. 5A, compression on the left side of the screen will result, as in Fig. 5B.

In order to be useful in TV service work, the scope should have retrace blanking. If it does not, the retrace line caused by the beam being returned from the right-hand side of the screen to the left may interfere with proper viewing of the waveshape. The blanking should be complete at all frequencies. Where there is no provision for blanking or it is not fully effective, reducing beam intensity may help minimize or eliminate the retrace. In the case of swept response curves, a blanking control may be provided on the sweep generator.

For maximum versatility the scope should be capable of synchronizing an input signal on either its positive or negative peak. It is also particularly useful to have external sync facilities or be able to use the 60-cycle line for sync.

A thorough reading of the manufacturer's instructions on the operation of the scope, in addition to a check of the specifications, will enable you to get the most out of it. This too will help you take into consideration any important factors in viewing and interpreting waveforms. As long as you know what to expect and can make allowances accordingly, within certain limits, you can expand use of the instrument to a surprisingly enlarged area of applications. The time invested in achieving this understanding is well worth while. You can save a good deal of time simply by not looking for defects in a unit under test when the defects are introduced by the scope itself.

—30—

New! Years Ahead!

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Use it as a Binaural-Stereophonic FM-AM tuner

Use it as a Dual-Monaural FM-AM tuner

Use it as a straight Monaural FM or AM tuner

KT-500 IN KIT FORM 74.50 7.45 DOWN 7.00 MONTHLY

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- Multiplex Output for New Stereo FM
- 11 Tubes (including 4 dual-purpose) + Tuning Eye + Selenium rectifier Provide 17 Tube Performance
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- Armstrong Circuit with FM/AFC and AFC Defeat
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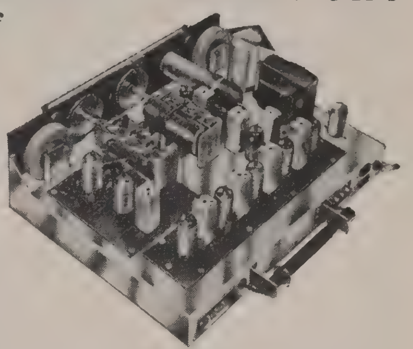

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control ''locks in'' FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8-kc bandwidth and frequency response 20-5000 cps ± 3 db.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt.,.22 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the ''Triumvirate'' of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500 ....Net **74.50**
LT-50 Same as above, completely factory wired and tested...........Net **124.50**

NEW! LAFAYETTE PROFESSIONAL STEREO MASTER AUDIO CONTROL CENTER

KT-600 79.50 IN KIT FORM
7.95 Down
8.00 Monthly

LA-600 COMPLETELY WIRED 134.50

The Lafayette KT-600 Solves *Every* Stereo/Monaural Control Problem!

- **UNIQUE STEREO & MONAURAL CONTROL CENTER FACILITIES!**
- **OUTSTANDING PERFORMANCE SUPERIORITY!**
- **AMAZING NEW BRIDGE CIRCUITRY & CONTROL FOR 3d CHANNEL OUTPUT FOR 3-SPEAKER STEREO SYSTEMS!**
- **VARIABLE CROSS-CHANNEL SIGNAL FEED ELIMINATES "PING-PONG" EFFECTS!**
- **PRECISE "NULL" BALANCING & CALIBRATING SYSTEM — BETTER THAN METERS!**
- **24 EQUALIZATION POSITIONS PER CHANNEL!**
- **CLUTCH-TYPE DUAL VOLUME-BALANCE CONTROLS!**

● RESPONSE 5-40,000 CPS ± 1 DB ● TAPE HEAD PLAYBACK EQUALIZATION FOR NEW 4-TRACK STEREO ● 2.2 MILLIVOLTS SENSITIVITY FOR 1 VOLT OUT ● LESS THAN .03% IM DISTORTION ● 6 CONCENTRIC FRONT PANEL CONTROLS ● 4 CONCENTRIC REAR PANEL INPUT LEVEL CONTROLS ● 180° ELECTRONIC PHASE REVERSAL

A REVOLUTIONARY DEVELOPMENT IN STEREO HIGH FIDELITY. Provides such unusual features as a Bridge Control, for variable cross-channel feed for elimination of ''ping-pong'' (exaggerated channel separation) effects and for control of a 3d-channel output for 3-speaker stereo systems; the 3d-channel output also serves for converting stereo program material to high quality monaural for recording or to play a stereo program monaurally through a separate amplifier and speaker system. The KT-600 also has full input mixing of monaural program sources (such as tape recorder and phonograph, etc.), a special ''null'' stereo balancing and calibrating system (better than meters), 24 equalization positions per channel, 12 db per octave rumble and scratch filters, and a loudness on-off switch. Has clutch-type dual concentric volume controls which operate independently for balancing or simultaneously as the Master Level Control. Other features include channel reverse, 180° phase reversal, input level controls at all inputs. Sensitivity is 2.2 millivolts for 1 volt out. Dual low impedance outputs (''plate followers,'' 1300 ohms) are provided. Frequency response is 5-40,000 cps ± 1 db; less than .03% IM distortion. Uses 7 new 7025 low-noise dual triodes. Size 14" x 4½" x 10⅛". Shpg. wt., 16 lbs. Complete with printed circuit board, modern-styling metal chassis and cage, profusely illustrated instructions, all necessary parts.

LAFAYETTE KT-600 Stereo Preamplifier Kit ....Net **79.50**
LAFAYETTE LA-600 Stereo Preamplifier, Wired..Net **134.50**

NEW! LAFAYETTE STEREO/MONAURAL BASIC POWER AMPLIFIER KIT

47.50

ONLY 4.75 DOWN
5.00 MONTHLY

- **36-WATT STEREO AMPLIFIER - 18-WATTS EACH CHANNEL**
- **EMPLOYS 4 NEW PREMIUM-TYPE 7189 OUTPUT TUBES**
- **FOR OPTIONAL USE AS 36-WATT MONAURAL AMPLIFIER**
- **2 PRINTED CIRCUIT BOARDS FOR NEAT, SIMPLIFIED WIRING**
- **RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS**
- **LESS THAN 1% HARMONIC OR INTERMODULATION DISTORTION**

A superbly-performing basic stereo amplifier, in easy-to-build kit form to save you **lots of money** and let you **get into stereo now** at minimum expense! Dual inputs are provided, each with individual volume control, and the unit may be used with a stereo preamplifier, for 2-18 watt stereo channels or, at the flick of a switch, as a fine 36-watt monaural amplifier — or, if desired, it may be used as 2 separate monaural 18-watt amplifiers! **CONTROLS** include 2 input volume controls, channel Reverse switch (AB-BA), Monaural-Stereo switch. **DUAL OUTPUT IMPEDANCES** are: 4, 8, 16 and 32 ohms (permitting parallel (monaural) operation of 2 speaker systems of up to 16 ohms. **INPUT SENSITIVITY** is 0.45 volts per channel for full output. **TUBES** are 2-6AN8, 4-7189; GZ-34 rectifier. **SIZE** 9-3/16"d (10-9/16" with controls) x 5¼"h x 13¼"w. Supplied complete with perforated metal cage, all necessary parts and detailed instructions. Shpg. wt., 22 lbs.

KT-310 Stereo Power Amplifier Kit .... Net **47.50**

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6-TRANSISTOR RADIO RA-6
Kit $29.95 Wired $49.95
INCLUDES F.E.T., LESS 9V BATTERY

Easy creative fun to build . . . a lifetime of big-set entertainment wherever you go . . . designed so that even the novice can build it & obtain a handsome professional assembly & outstanding performance. American-made modern super-heterodyne all-transistor circuitry, plus finest quality parts throughout, assure you of highest durability & stability. • high sensitivity & selectivity • big-set volume & tone quality with 4″ x 6″ PM speaker & 250 mw push-pull audio output stage • built-in Ferrite rod antenna for good reception in any location • pre-aligned RF & IF transformers • planetary vernier tuning (7:1 reduction) for easy station selection & tuning • high-impedance earphone jack for private listening; eliminates drain of output stage when using earphone • attractive tan leatherette case, retractable handle • compact: 8½″ w, 4½″ h, 2½″ d. Only 3 lbs.

Build the BEST BUYS in "HAM" gear... EICO®

*U.S. PAT. NO. D-184,776

90-WATT CW TRANSMITTER* #720
Kit $79.95 Wired $119.95

"Ideal for veteran or novice" — ELECTRONIC KITS GUIDE. "Top quality" — POPULAR ELECTRONICS. "Well designed" — ELECTRONICS WORLD. 80 thru 10 meters with one-knob bandswitching. Full "clean" 90W input, 65W external plate mod. Matches loads 50 to 1000 ohms. May be used as basic exciter unit. TVI shielded. Tubes: 6146, 6CL6, 2-6AQ5, GZ34. Attractive "living room" low-silhouette design. 15″ w, 5″ h, 9″ d.

UNIVERSAL MODULATOR-DRIVER #730
Kit $49.95
Wired $79.95
Cover E-5 $4.50

Delivers 50W undistorted audio. Modulates transmitters having r.f. inputs up to 100W. Output transformer matches 500-10,000 ohms. Low-level speech clipping & filtering. Inputs for xtal or dynamic mikes, phone patch, etc. 7 tubes. 6″ h, 14″ w, 8″ d.

GRID DIP METER
Kit $29.95
Wired $49.95 #710

Includes complete set of coils for full band coverage. 400 kc–230 mc in 8 overlapping ranges. 500 ua meter. Plug-in coils are pre-wound, pre-calibrated to 0.5% accuracy. Transformer-operated power supply. 2¼″ h, 2 9/16″ w, 6⅞″ l.

ADD 5% IN THE WEST

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New Citizens Band Equipment

CITIZENS BAND TRANSCEIVER

Globe Electronics of Council Bluffs, Iowa has just introduced a completely assembled transceiver for the 11-meter band which is being marketed as the "Citizens Broadcaster CB-100."

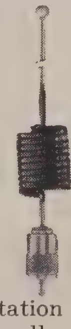
The new unit, which measures only 13″ x 10½″ x 3½″ and weighs 9 pounds, features a channel switch which allows choice of three channels for transmitting and receiving; operation on either 117-volts a.c. or 12-volts d.c.; only three controls with no tuning required; push-to-talk operation; squelch control to subdue background noise for muted standby operation; 10 tubes; and AM modulation.

The transceiver is housed in a modern, high-styled cabinet with a carrying handle which acts as a tilt stand for fixed operation. The unit comes complete with crystals for one channel and a push-to-talk microphone.

For a data sheet on the CB-100, write the manufacturer direct.

CITIZENS SERVICE ANTENNAS

The Antenna Specialists Co., 12435 Euclid Ave., Cleveland 6, Ohio has just released a new line which includes fifteen antennas which have been especially designed for applications in the 11-meter Citizens Band service recently authorized by the Federal Communications Commission.



This new series of antennas, which includes versions for applications in mobile, portable, and fixed location station uses, can be employed with any or all equipment designed to operate in the newly assigned 27 mc. service. Included are portable radio antenna rods, base-loaded portable whips, antenna base-loading coils, auto gutter clamp units, ground-plane antennas, side-cowl-mounting antennas, as well as bumper units and home and window masts.

A data sheet giving specifications on all these units will be forwarded by the manufacturer on written request.

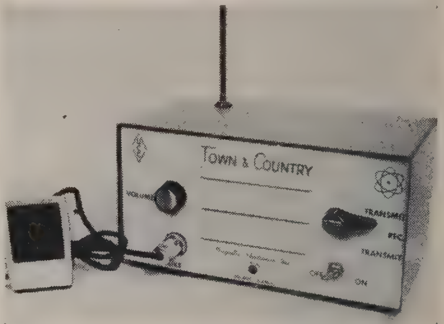
"TOWN AND COUNTRY" UNIT

Utica Communications Corporation, 19 South La Salle Street, Chicago 1, Illinois is now in production on its "Town and Country" transmitter-receiver unit which will operate on 117-volt a.c. or 6- or 12-volt auto or boat battery systems.

The unit is fully portable and requires no tuning or technical adjustments of any kind. Installation is confined to connecting the antenna, plugging into the power line, and turning a switch. These portables are being sold in matched pairs which operate on the same channel. Additional units may be incorporated as required.

The units come equipped with microphones and portable whip antennas. For fixed locations the manufacturer is offering a series of antennas as well as various accessories such as car mounting brackets, a telephone-type headset, mobile base-loaded antenna, etc.

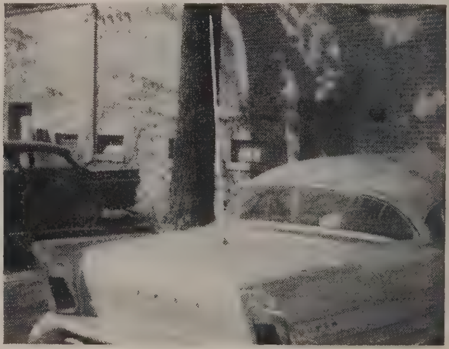
The entire unit is shockproof, moistureproof, and dustproof. It comes completely assembled and with antenna, cables, and microphone. For information on price and additional details write Dept. EW of the company direct.



"HELIWHIP" MOBILE ANTENNA

Mark Mobile, Inc., 6416 W. Lincoln Ave., Morton Grove, Ill. is currently offering its Model HW-11 "Heliwhip" antenna which has been especially designed for vehicular mobile services in the 27 mc. Citizens Band service.

The Model HW-11 is four feet long over-all and is self-resonant at 27 megacycles with no external loading coils, etc. required. The tapered helical radiator provides efficient service in vehicular mobile and portable applications.



The Model HWM-1 molded plastic base mount unit is available for vehicular installation and, in addition, units with PL-259 connectors integral to the antenna for direct mounting to the Citizens equipment for portable or semi-fixed service will be available. For fixed station installations, the "Heliwhip" is available in a ground-plane design.

HEATH TRANSCEIVER KIT

Heath Company, Benton Harbor, Michigan has added a Citizens Band transceiver to its extensive line of electronic gear in kit form.

The Model CB-1 has been designed to meet all FCC requirements for two-way radiotelephone communication on the new Class D 11-meter band. The transceiver is light, compact, and easy to assemble. A single switch selects either "transmit" or "receive" while a single receiver tuning control selects any of the 23 assigned channels. The third knob controls volume and turns the unit on or off. The kit comes complete with microphone, station identification card, pertinent FCC regulations and application forms, a sheet of adhesive-backed letters and numbers for affixing call letters on front panel, and crystal for one channel.

The receiver portion is a superregenerative detector with r.f. stage. Power input is 5 watts to the plate of the final r.f. amplifier. Transmitting frequency is controlled by a third overtone crystal which operates within the ±.005% limits set by the FCC. AM plate modulation is limited to less than 100%.

The transceiver is designed for 117-volt a.c. operation. The unit may be used on 6- or 12-volt battery systems with the addition of the company's accessory vibrator supply. Cabinet dimensions are 8" x 6" x 9¾".

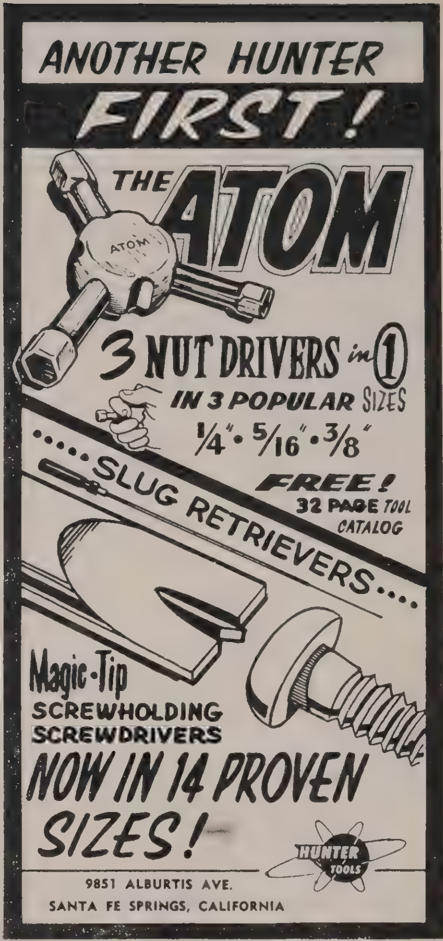
Available accessories include three antennas and two power supplies. The manufacturer will supply full details and price on this transceiver kit upon written request. —30—

G-E COLOR MOVIE

THE Receiving Tube Department of General Electric Company has just released a full-length color film based on the design and manufacture of receiving tubes.

Entitled "The Teacher Wore White," the new film will be made available to distributors, manufacturers, engineers, radio clubs, schools, professional societies, libraries, etc. It runs approximately 40 minutes.

Although the script includes a "plot" and a "love story," it conveys a great deal of pertinent information about the processes involved in making receiving tubes. The Department, Owensboro, Ky., will supply booking details. —30—



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NEW COURSE COVERS EVERYTHING IN TV

Let these course-lessons take you into TV servicing the easy way. The very first lesson of this sensational course tells how to do simple repairs. You can start earning money immediately. Second lesson tells you what is wrong by just looking at the picture—no instruments used. **Lesson 4** has 32 large, 8½x11" pages and 28 helpful illustrations on antennas. Also 12 full lessons on trouble-shooting, alignment, UHF, test equipment, picture analysis, and all types of new circuits. Greatest training value, only $3, postpaid.

With this new **course** you will find yourself doing TV repairs in minutes—instantly finding faults. Most amazing bargain, on par with **Supreme** famous service manuals. You are invited to examine. Send **no-risk** coupon.

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New, easy-to-follow, well illustrated 14 lessons on circuits, picture faults, adjustments, short cuts, about UHF, alignment, antenna problems, trouble-shooting, service hints, how to use test equipment. Many large practical sections prepared by leading manufacturers. Recently published. Send trial coupon right now. Your special price, complete, only........ $3

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Here are lessons that are easy to follow and apply to actual repairs jobs. Well illustrated sections on test equipment, circuits, alignment, F.M., audio, transistors, and every other topic needed to be an expert in radio servicing. Includes trouble-shooting hints, service short cuts, new developments, self-test questions. Use on trial at our risk. All lessons, in large manual form, plus material described, postpaid only............ $2.50

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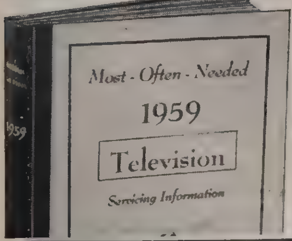

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SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

• Uses new improved SICO printed circuitry. • Employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability • Meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS value if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Model 77—Vacuum Tube Voltmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SPECIFICATIONS

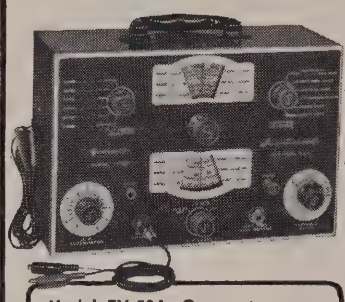
• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak) — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Complete with operating instructions, probe, leads, and case. 110-120 volt 60 cycle. Only .... **$42^50**

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!



- ✓ **R.F. Signal Generator for A.M.**
- ✓ **R.F. Signal Generator for F.M.**
- ✓ **Audio Frequency Generator**
- ✓ **Marker Generator**
- ✓ **Bar Generator**
- ✓ **Color Dot Pattern Generator**
- ✓ **Cross Hatch Generator**

This Versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

- **A.M. RADIO**
- **BLACK AND WHITE TV**
- **F.M. RADIO**
- **COLOR TV**
- **AMPLIFIERS**

Model TV-50A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc.; 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

The Model TV-50A comes complete with shielded leads and operating instructions. Only .... **$47^50**

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- ✓ **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing. when you use Model 80.
- ✓ **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.
- ✓ **CAPACITY RANGES** permit you to accurately measure all condensers from .0025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- ✓ **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

Model 80—Allmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

FEATURES:

• A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.

• Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure unchanging accurate readings on all ranges.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES:
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES:
— 6 db to + 18 db. + 14 db to + 38 db + 34 db to + 58 db

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only .... **$42^50**

RCA RADIATION COUNTER

MADE TO SELL FOR $160 — OFFERED FOR ONLY **$47^50 NET**
(Much less than cost of Manufacture.)

INDICATES RADIOACTIVITY IN 3 WAYS!
1—BY NEON
2—BY PHONE
3—BY METER

RADIOACTIVE SPECIMEN

Endless experiments and discoveries in the new exciting field of nuclear energy are made possible when you acquire this finely built and engineered device. In the past, a rugged counter which was suitable for the prospecting of radio-active ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks.
In the laboratory where determination of intensity (counts) of a reading are necessary, the WF-11AWB provides sensitivity for surpassing many laboratory counters.

RCA Radiation Counter
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

SPECIFICATIONS

Employs the extra sensitive 6306 Bismuth Type Geiger Counter Tube. Sensitivity is .015 Roentgens per hour (1 MR/HR=6600 counts per minute) • Three counting ranges: 0-200/2,000/20,000 counts per minute. • Handy reset button. • Ideal for survey work because the complete unit weighs only 5½ lbs. • Sight and sound indications by neon flashes and headphone. Then when an indication is obtained you switch to meter reading for exact measurements. • Decontamination easy with damp cloth applied to the weatherproofed aluminum case. • A radioactive specimen is included for instrument checking and experiments. • Included at no extra charge—U. S. Atomic Energy Commission booklet titled "Prospecting with a Counter." • R.C.A. Model WF-11AWB comes complete with self-contained batteries which provide over 200 hours of intermittent operation.

Comes with complete set of batteries, carrying strap, headphone, radio-active specimen and A.E.C. booklet. Only... **$47^50**

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES: Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. **$47.50**

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert tube into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

***THAT'S ALL!* Read emission quality direct on bad-good meter scale.**

SPECIFICATIONS

- Tests over 600 tube types
- Tests OZ4 and other gas-filled tubes
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence
- Dual Scale meter permits testing of low current tubes
- 7 and 9 pin straighteners mounted on panel
- All sections of multi-element tubes tested simultaneously

Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more — and as proof, we offer to ship it on our examine before you buy policy.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch — THAT'S ALL! Read quality on meter. Inter-element leakage if any indicates automatically.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only **$36.50**

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS AND REJUVENATES ALL PICTURE TUBES

Model 83—C.R.T. Tube Tester
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types —from 8" to 30" types.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton—in the set!

- Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.
- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only.. **$38.50**

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NO MONEY WITH ORDER—NO C.O.D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC, INC.
Dept. D-652, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligations.

Name ....
Address ....
City ....Zone....State.......

All prices net, F.O.B., N. Y. C.

☐ Model 77...Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model TV-50A..Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 80...Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ RCA Radiation Counter... Total Price $47.50; $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TW-11 ..Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 82A.. Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model 83.. Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.

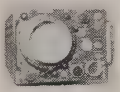
BUY NOW—*WHILE THEY LAST!*

BC-603 FM RECEIVER

20 TO 27.9 MC.
GOV'T. RECOND.... $14.95

BC-683—FM RECEIVER—27 to 39.1 MC ....Used: $22.95
BC-684—TRANSMITTER—27 to 39.1 MC ....Used: $7.95
AC POWER SUPPLY for BC-683-603.....Kit $10.00—Wired: $14.95
BC-604—TRANS.—20 to 27.9 MC—Used: $4.95—Re-New: $7.95
FT-237 Mounting F/Trans. & Rec......Re-New: 4.95
FT-346—Mounting F/Receiver Only.....Re-new: 4.95
DM-34 12 V Dyn F/MC-683-603.U: $2.95—R-N: 4.95
DM-35 Dyn. F/BC-684-604......U: $7.95—R-N: 9.95

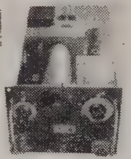
RADAR DIRECTION FINDING OSCILLOSCOPE



IP-94/APA-17: Amplifies and gives visual indication of the relative bearing of radar or radio signals in the Freq. range of 250 to 1000 megacycles when used in conjunction with a receiver covering the same range. May be adapted to use on other Freq. or converted to an oscilloscope. Complete with 1/5JP2 Cathode Ray Tube, 2/6AC7, 2/6H6, 1/6SH7, 1/6SJ7, 1/6V6, & 2/2X2 tubes. Voltage required: 115 Volt 400 cycle & 24 Volts. Price.........Used: $12.95

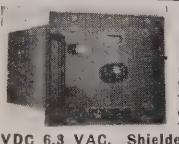
PULSE ANALYZER And OSCILLOSCOPE

IP-148/APA-11A RADAR PULSE ANALYZER with repetition Freq. of 200 to 6000 CPS with either a negative or positive pulsed signal. Has calibrated dials for pulse width & rate. Used with APR-1, APR-4, and other receivers. Also can be used as an oscilloscope. Complete with 1/3JP2 Cathode Ray Tube, 6/12AT7, 2/6AG7, 2/6AG5, 2/2X2, & 1/5R4 Tubes. Voltage required: 115 V 400 cycle & 24 Volts..USED: $19.95



RECEIVERS:

BC-733 Localizer Rec.—108.3 to 110.3 MC.Used: $ 7.95
ARB-Receiver—190 to 9050 KC..........Used: 18.95
R-23/BC-453 Rec.—190 to 550 KC........Used: 14.95
R-27/BC-455 Rec.—6 to 9 MC..........Used: 8.95
R-4/ARR-2 Rec.—540-830 KC; 230-258 MC.R-N: 8.95
BC-1206 Beacon Receiver—200 to 400 KC.Re-N: 9.95
BC-652 Receiver—2 to 6 MC—Less Dyn...Used: 19.95
BC-342 Receiver—1.5 to 18 MC For AC op. Used: 69.50
BC-312 Receiver—1.5 to 18 MC Less Dyn.Used: 59.50
BC-344 Rec.—150 to 1500 KC—For AC op. Used: 49.50



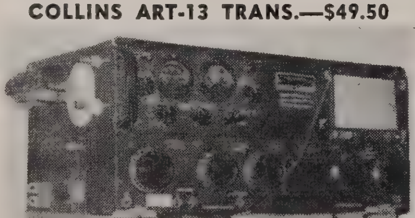
UHF CONVERTER

100 to 225 MC Western Electric FM Converter. Plug in Unit. Covers Freq. 100 to 225 MC with 30 MC resultant freq., & tuneable dial. AFC + or — control, using 1/6J4 & 1/5670 tubes. Voltage required 150 VDC 6.3 VAC. Shielded in cast aluminum. Size: 7¼ x 6½ x 9½"—AM-913/TRC............New: $34.95

KEYERS, TELEPHONES, HEADSETS, MICS.

TS-9 Handset................Used: $2.95—New: $ 3.95
TS-13 Handset. w/PL-55 & PL-68.U: $2.95—N: 3.95
T-17 Microphone ....Used: $3.95—New: 6.95
CM-1-SC Hand Carbon Mic.—Mobile type..New: 6.95
EE-8 Field Telephones..Used: $12.95—Recond.: 16.95
BD-71 Switchboard—6 Line.....U: $14.95—New: 24.95
BD-72 Switchboard—12 Line...U: $24.95—New: 34.95
RM-29 Control Unit....New: $6.95—W/Handset 8.95
RM-52 Control Unit (Patch Found.) U: $1.95—N.: 2.95
H-16/U Headset—8000 ohm.....U: $1.95—New: 2.95
HS-33 Headset—300 ohm.......U: $4.95—New: 7.95
TG-34 Keyer F/Code Practice.........Re-New: 22.95
Code Practice Tapes, Inked Paper—15 to Set.N.: 16.95
J-45 Tel. Key with cord and plug..........New: 1.50

COLLINS ART-13 TRANS.—$49.50



2 TO 18.1 MC—100 WATT—PHONE, CW, MCW

The most desired Set on the surplus market—Easily converted to 10 Meters (See Surplus Conversion Manual No. 2—$2.50). Automatic Tuning for selection of 11 Channels in the Freq. Range. Tube Line-Up: 1/837, 1/813, 2/1625, 1/12SJ7, 2/6V6, 2/811, 2/12SL7, 1/12SA7. AC Power Supply requirements: 28 VDC/10 A, 400 VDC/225 MA & 1250 VDC/250 MA. Size: 23⅝ x 16 x 11⅜. Wt.: 70 lbs. Price, USED: $49.50
Price—Same as above—except, Less Tubes...... 30.00
DY-12/ART-13 24 V. Dyn. w/Filter & Relays—U: 12.95

BATTERY PACKS—POWER SUPPLIES

BA-41 Battery—F/BC-659 & BC-620......New: $ 4.95
BA-38 Battery—F/BC-611, 721, SCR-625.New: 5.95
PE-120 Pow. Sup.—12 V, F/BC659 & 620.Re-N: 7.95
RA-20 AC Pow. Supply For BC-312......Used: 10.95
PE-237 Pow. Supply F/BC-1306 & GRC-9.Used: 14.95

LARGEST VARIETY of SURPLUS EVER OFFERED! See CATALOG F-59!

Address Dept. RN • All Prices F.O.B., Lima, Ohio. Minimum Order $5.00, & 25% Deposit on all C.O.D.'s

FAIR RADIO SALES
132 SOUTH MAIN ST. • LIMA, OHIO

Manufacturers' Literature

MOBILE SERVICES

Kaar Engineering Corporation, 2995 Middlefield Road, Palo Alto, California, is offering copies of its new brochure, "Repeater Operation in the Mobile Services," without charge.

The brochure describes the function of a repeater unit for extending the communications range from the base station to mobile. A description of the use of the unit as a mobile relay for extended car-to-car communications is also included along with the unit's application as a combination base repeater and mobile relay unit.

NEW TUBE BULLETIN

G-C Electronics Mfg. Co., Rockford, Illinois, has issued a technical bulletin which illustrates and describes its *"CTS* Save-A-Tube." This brochure is available free of charge from the company.

The bulletin explains how the unit helps to reduce color and black-and-white television tube failures and how to eliminate unprofitable callbacks by the service technician.

Also included are prices and typical television circuit applications.

TRANSISTOR FAILURES

Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, California, is issuing a four-page publication which discusses voltage breakdown, the major cause of transistor failures.

Known as "Transistor Kinks," Volume 1, No. 1, the brochure lists five types of voltage breakdown and their effect on transistors.

Information on leakage currents is also included. Three types which are closely related to the breakdown voltages of transistors are defined and discussed.

ELECTRON TUBE DIRECTORY

Metropolitan Supply Company, 1133 Broadway, New York 10, N. Y., is now supplying copies of its "Directory and Buyers Guide for Electron Tubes." Free copies may be obtained by writing to the firm on company letterhead.

This new "Directory" covers almost every tube made by American manufacturers. Top name brands as well as specialized brands are listed. Receiving, television, and special purpose tubes are all listed by their type numbers.

CLAROSTAT 1959 CATALOGUE

Clarostat Mfg. Co., Inc., Dover, N. H., has released its 1959 general catalogue. A copy may be obtained from any of the firm's distributors or direct from the company.

The catalogue, No. 59, covers the general line of stock resistors, controls, and resistance devices available to and through the company's distributors.

This latest edition includes several new products and additional listings such as tab-mount controls used in servicing and the new miniaturized wirewound Series 57 precision potentiometers.

IRC CATALOGUE SHEET

International Resistance Company is offering its newest catalogue sheet, DC8. Copies are available from the firm's distributor sales division, 414 North 13th Street, Philadelphia 8, Pa.

This new sheet describes the firm's "Multi-Range" resistor line and the "Multi-Range" kit. Simple circuit diagrams and complete instructions for making the interconnections are included in each unit and are reproduced in full on the catalogue sheet.

CLEVITE BROCHURE

Clevite Electronic Components Division, Clevite Corporation, 3311 Perkins Avenue, Cleveland 14, Ohio, is offering a new eight-page, 8½ x 11 inch illustrated two-color brochure which describes a line of miniature ceramic i.f. bandpass filters.

The blue-and-white booklet lists a wide range of bandpass characteristics and includes attenuation curves for narrow- and wide-band applications in commercial and military equipment.

HEATH SUMMER FLYER

Heath Company, Benton Harbor, Michigan, is offering its newest flyer. The 28-page booklet covers the firm's line of high-fidelity components, both monophonic and stereo, as well as a "Selector Chart" covering favorite sources of high-fidelity entertainment and then the components required for each system in order of advancing price brackets.

Also included in the brochure are items of test equipment, ham equipment, and marine accessories. The company is also offering several new items, among them a transistor code practice oscillator kit and an educational electronic analogue computer kit.

ENGINEER'S HANDBOOK

CBS Electronics, Danvers, Mass., has just expanded its "Engineer's Handbook" into two volumes.

Covering receiving, special purpose, and picture tubes, as well as semiconductors, the Handbook now includes complete EIA engineering design data on current types. The compact, 8¼ x

9⅞ inch volumes contain over 700 pages. Their sturdy, hard covers and 16-ring binders are designed to withstand hard usage.

The two volumes are available direct from the company at $10.00 for the pair. Periodic supplement service for a two-year period is optional at an additional $3.00. Present Handbook owners can obtain separate hard-cover binders for $3.00 each; two for $5.50.

NEW TECHNICAL MANUAL

Sylvania Electronic Tubes, a division of *Sylvania Electric Products Inc.,* has announced a new technical manual which lists the characteristics and rating of over 1800 electron devices manufactured by the company. The manual is available at a cost of $3.00 per copy from the firm's distributors.

This new edition, the eleventh, contains technical data on over 1000 receiving tube types, 250 special purpose tubes, 265 television picture tubes, 110 transistors, and 138 crystal diodes. Supplemental sheets, containing technical information on new and/or revised tubes, will be packet mailed every three months.

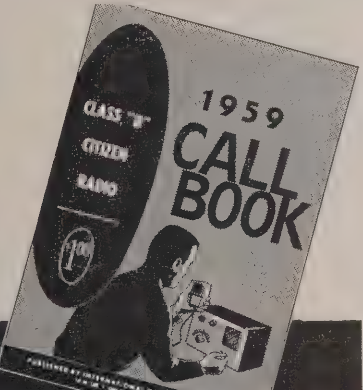
New features appearing in the latest edition include: "Audio Power Output Types," "A Transistor Characteristics Chart," "A Microwave Diode Chart," "A Cathode-Ray Phosphor Chart," and "An American-European Substitution Chart."

CENTRALAB SUPPLEMENT

Centralab, Division of *Globe-Union Inc.,* 900 E. Keefe Ave., Milwaukee 1, Wisc., is offering a supplement to its "Auto Radio Control Replacement Guide." It is available without charge from the firm's distributors or by writing direct to the company.

The supplement lists exact replacement data for the company's new line of "on-off," push-button radio switches used in *Chrysler, DeSoto, Dodge, Ford, Hudson, Lincoln, Mercury, Plymouth* and *Thunderbird* push-button radios. Over 60 replacement applications for these switches are listed.

—30—



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WESTON INSTRUMENTS: STANDARDS OF STABILITY IN SCIENCE AND INDUSTRY

New design of the Weston
MARK II ANALYZER
offers . . .

- INCREASED RANGE
- MORE RUGGEDNESS
- SMALLER SIZE

The Weston Mark II Analyzer is an all-new version of the highly sensitive Model 980 Volt-Ohm-Milliammeter. It's engineered to provide a wider range of test measurement applications . . . to stand up to abuse and environment better than ever before.

With its high-voltage range extended to 4000 volts, the Mark II offers a D-C sensitivity of 20,000 ohms/volt . . . accuracy within 2% of full scale. Range and function-switching is greatly simplified by use of a single dial control.

The CORMAG® mechanism assures magnetic shielding . . . the spring-backed jewels, shock and vibration resistance . . . the meter housing, electrostatic shielding . . . the case, impact resistance. And the ohm ranges are fuse protected.

Order from your local distributor. Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

WESTON
A DAYSTROM UNIT
Instruments

IMPORTANT NEW
SAMS BOOKS

"Television Antenna Handbook"
by Jack Darr

A practical guidebook for the antenna installer and serviceman. Thoroughly covers the requirements of each reception area (primary, secondary, fringe and far-fringe). Chapters include: The TV Signal—From Transmitter to Receiver; Characteristics of Basic Antennas; Commercial TV Antenna Types; Transmission Lines; Antenna Rotators; Planning the Installation; On-Location Tests; Tools and Equipment; Towers, Masts and Guying; Roof-Top Techniques and Safety; Installing Antenna and Lead-in; Noise, UHF and Color; Unusual Installations; Servicing the Antenna System. Most complete and practical book available on the subject. Illustrated; 248 pages; 5½ x 8½"; only $3.95

"Photofact Television Course"
All-New 2nd Edition

Completely revised edition of the famous Course which has helped in the training of thousands of successful technicians. Covers the complete subject of monochrome TV in three unique study sections. The emphasis is on the practical theory and operation of receiver circuits. Each section is built around a requirement of the picture tube, until every circuit in the TV receiver is covered. The course includes step-by-step descriptions of the functions of all important circuits, supported by many schematics of actual commercial circuits. Clearly written for easy understanding. The ideal course for students, service newcomers and hobbyists. Fully illustrated; 192 pages; 8½ x 11"; only $3.95

"Video Speed Servicing" Vol. 3

Latest volume in this valuable reference manual series. Presents 456 practical troubleshooting hints that will cure hard-to-find faults in some 87 chassis of late-model TV receivers. All models are indexed by brand name, model and chassis number for quick reference. An invaluable aid for shop bench use; each hint is accompanied by an explanatory diagram or schematic. 160 pages, 8½ x 11"; only......... $2.95

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New Audio Test Report

ELECTRONICS WORLD LAB TESTED

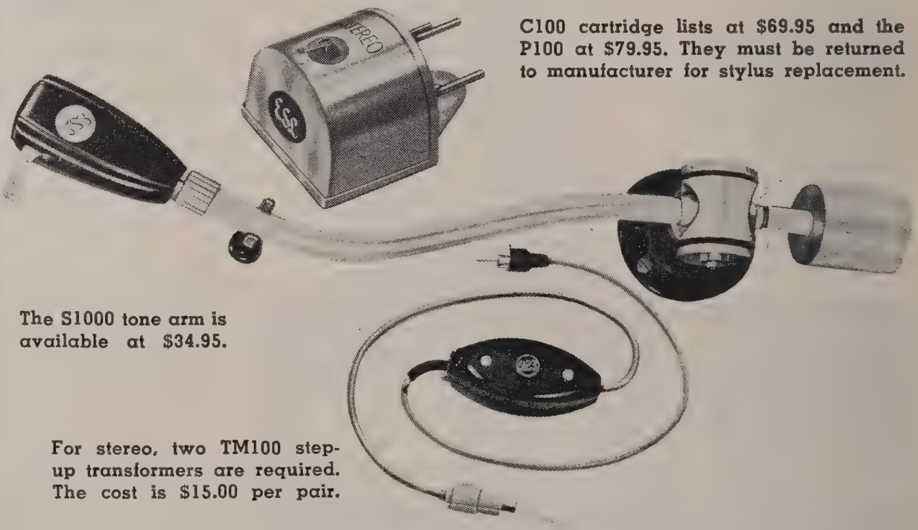
ESL STEREO CARTRIDGE AND ARM

THE *ESL* moving-coil stereo cartridge is not the most recent design on the market but this is the first opportunity we have had to check it. Actually, time is always against us as there are so many products to be tested and just not enough hours in a day. In this case however, such delays were rewarding as they certainly indicate that *ESL's* reputation as a producer of professional-quality monophonic cartridges will carry over in the stereo field.

The design differs from other cartridges in the field in that to obtain sufficient output, two step-up transformers (one for each channel) must be used. With these transformers the average output voltage per channel is 14.5 mv. (at 5 cm./sec.). This is adequately high and is more than that required to drive most hi-fi systems to their full output.

The matching transformers, contrary to other opinions, will not produce any hum problem unless one foolishly lets them rest near the transformers of the power amplifier. The over-all hum pickup of the cartridge and matching transformer was no higher than that of some other high-quality cartridges on the market and better than many.

ESL has two stereo cartridges: the C100 which mounts in any tone arm and the professional P100, to be used solely with a specially designed arm. Since we checked the C100 version, it is difficult for us to comment on the P100. We would assume that the latter may be hand-picked for top quality. Both require 47,000-ohm loads and track at 2 to 4 grams. We checked ours at 3 grams and used a *Rek-O-Kut* S120 tone arm. This arm was chosen to check the cartridge since we had previously checked the *ESL* arm, which in our opinion, is one of the best available today. It is the only arm we have checked that operates with the turntable 70 to 80 degrees from horizontal. Admittedly this is a ridiculous position to play records, but it does back up the claim that the arm is independent of gravity. Accurate turntable levelling is not a "must" with this arm.

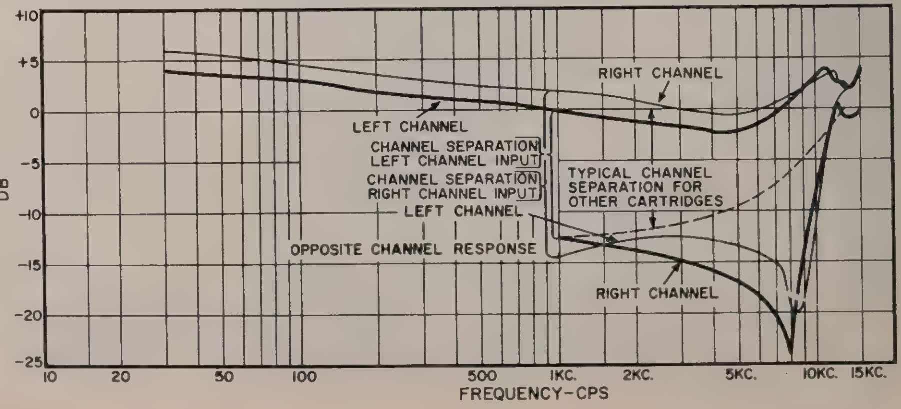


C100 cartridge lists at $69.95 and the P100 at $79.95. They must be returned to manufacturer for stylus replacement.

The S1000 tone arm is available at $34.95.

For stereo, two TM100 step-up transformers are required. The cost is $15.00 per pair.

Frequency response and channel separation obtained with a Westrex 1A test record.



The frequency response and channel separation characteristics of the cartridge are plotted on graph at left. Channel separation characteristics should be of particular interest to anyone who desires real spacial depth in his stereo reproduction. Note that the average channel separation is about 14 db at 1000 cycles and then increases sharply to about 23 db at 8000 cycles. Most cartridges have a channel separation following the dashed line shown on the graph, resulting in far less separation at the high end. As to why the *ESL* cartridge provides better, although unusual, performance in this area is hard to analyze. We do not have the answer and neither does *ESL*. It is obviously inherent in the design.

As to a listening test, the best way to describe the performance of the cartridge is to say that one hardly realizes that the cartridge is in the circuit. There is no tonal coloration and no trouble was encountered when playing sharp peaks or monophonic records. —30—

THE REGENCY TRANSISTORIZED PREAMP

IT is rather difficult, at the present time, to determine if transistors will ever play a major role in the design of commercially available hi-fi equipment. Even now, however, transistors can play a limited role in high-fidelity since they do have several important advantages over tubes; namely, compactness (this is important where space is at a premium), battery operation (a major factor where a.c. power sources are not available and where portable or mobile operation is desired) and, of course, hum and microphonic reduction. One of the major problems at present is the difficulty in obtaining sufficient power output at low enough distortion from transistors. When this problem is solved, we would no longer require costly output transformers since transistors, with their extremely low output impedances, could be connected directly to the speaker.

One manufacturer on the West Coast has announced a completely transistorized integrated stereo amplifier that, according to the announcement, will provide 20 watts output per channel. This is just an example of what is being planned and we look forward to checking this unit as soon as production is underway.

Another example of the application of transistors in hi-fi gear is the work being done at *Regency*, a division of *I.D.E.A., Inc.* The firm has just announced a three-transistor, single-channel preamplifier which is being offered in either completely assembled or kit versions. The kit employs a printed circuit board and the construction is so simple that we were able to complete the entire assembly in only 2½ hours. Over-all size of the preamp

(*Continued on page* 106)

WHO NEEDS
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GET
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Change 6 or 12 volt D.C. to 100 volt, 60 cycle A.C.

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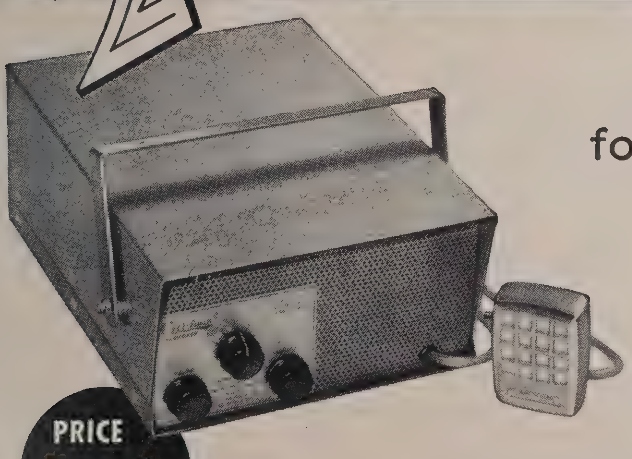

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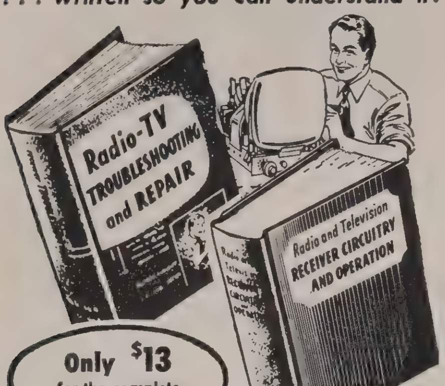
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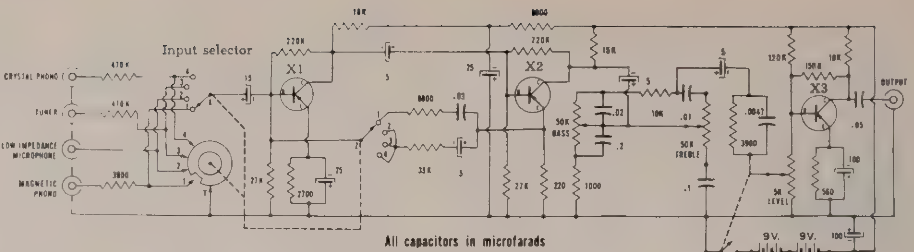

All capacitors in microfarads
All resistors in ohms

Fig. 1. Diagram of the Regency preamplifier. Apparently the company uses several different sources of supply for the transistors since they were not identifiable.

is 7½"x2½"x3⅞" and it weighs only 29 ounces, including batteries. It can be operated from either one or two 9-volt batteries. For test purposes we used 18 volts since better operation was thus obtained. Provision is made for four separate inputs: tuner; crystal or ceramic cartridge (or output of a tape recorder amplifier); magnetic phono cartridge; and a low-level dynamic or ribbon microphone. Operating controls are bass, treble, and volume along with input selector switch. Our test results are as follows:

Sensitivity: for 1 v. output; magnetic phono input 9.1 mv.; ceramic phono input .4 v.; microphone input 550 mv.; tuner input .43 v. The magnetic phono input sensitivity is somewhat low; hence the unit not suitable for low-output cartridges. It would, however, be satisfactory with high-output cartridges such as the *G-E* variable reluctance type.

Frequency Response: flat (±.15 db) from 30 to 15,000 cps.

Tone Controls: bass, 12.1 db boost, 16.5 db attenuation at 30 cps; treble, 7.5 db boost, 22.7 db attenuation at 15,000 cps.

IM Distortion: 1.1% (tuner input) with 1 v. in and 1 v. out (equivalent sine wave, 4 to 1 ratio, 60 and 6000 cps).

Harmonic Distortion: tuner input with 1 v. in and 1 v. out; .17% at 20 cps; .32% at 1000 cps; 1.02% at 15 kc.; and .95% at 20 kc. The IM distortion is just a little high while the harmonic distortion is relatively low. Both, however, are within the range required for high-fidelity reproduction.

The method used in this design to obtain proper RIAA phono equalization requires some comment at this point. Referring to the schematic diagram, Fig. 1, the 6800-ohm resistor and the .03-μf. capacitor between the emitter of the second transistor and the base of the first transistor constitute a bass-boost feedback network. This was found to provide proper RIAA equalization (within 2.6 db) below 1000 cps. Since transistorized circuits have such low input impedances, which may be used for cartridge loading, a special high-end RIAA equalization network is not included in the circuit.

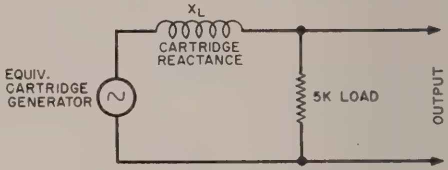

Fig. 2. Equivalent circuit of typical magnetic cartridge.

For example, a *G-E* variable reluctance monophonic cartridge has an inductance of 500 mhy. and a d.c. resistance of 415 ohms. The cartridge reactance (X_L) will change with frequency, being 5000 ohms at 1.6 kc., for example, and 50,000 ohms at 16 kc. Assuming the output load is a constant 5000 ohms (see Fig. 2), the load and the cartridge reactance form a voltage divider that attenuates the signal 20 db at 16 kc. This, in essence, is the method of rolling off the highs as is required for RIAA equalization.

The preamplifier is designed around the *G-E* cartridge. Other cartridges, however, can be used with minor circuit variations. The instruction manual accompanying the preamp provides details on several other cartridges.

As mentioned previously, hum in transistorized equipment is not usually a major problem but noise is. Our tests, which combine hum and noise in a single measurement, show a total figure of 58 db down from 1 volt.

Although the measurements turned out favorably, we do not, however, intend to imply that this unit would compare with any of the higher-priced tube preamplifiers available. It was not intended to compete at this level. For one thing, it does not have the flexibility of operation. But the unit does have the characteristics of compactness and battery operation. For those who are interested in these features, the unit would be a suitable addition to a hi-fi system. —30—

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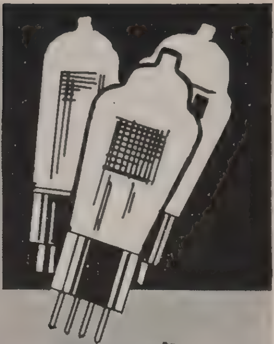

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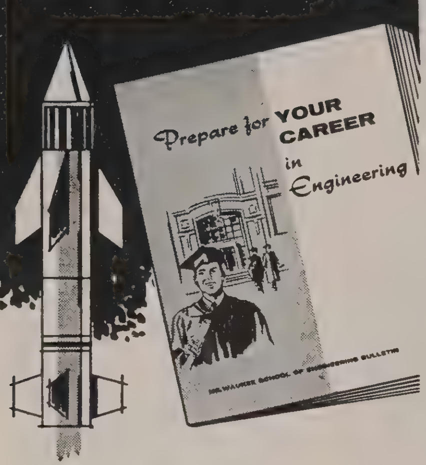
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(*Continued from page 44*)

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Electronic Circuitry

The block diagram, Fig. 4, illustrates the basic operation performed by the electronic circuits shown in the schematic diagram of Fig. 3.

The three transistors, V_5, V_4, and V_3 are the timing circuits whose function is to produce a negative-going gate, ¾ msec. long every 1/24th second. This gate is used to turn on the 200-kc. oscillator.

V_2 is the gated oscillator. Capacitors C_3 and C_4 along with L_2 form a resonant tuned circuit. The resonant frequency of operation is approximately 200 kc. Upon removal of the negative gate, oscillations will cease. V_1, a buffer circuit, has been placed between the transducer and the oscillator to prevent loading on the oscillator.

Echoes are picked up by the transducer, then applied to V_6 and V_7, the direct-coupled receiver r.f. amplifier. This second stage is tuned by C_{17}. Signals are then coupled through an emitter-follower V_8 to the detector.

The diodes CR_2 and CR_3 form a voltage-doubler circuit where a negative gate is formed from the r.f. pulse. This is coupled to V_9, an emitter-follower used so as not to load the detector circuit. This pulse is then amplified and inverted by V_{10} and differentiated (peaked) for application to V_{11} and V_{12}.

V_{11} and V_{12} act as a switching multivibrator for metering. Because of diodes CR_4 and CR_5, only the positive peaks are applied to the circuit. Such peaks, obtained from the receiver, are applied through S_3 and CR_5 to the base of the right-hand transistor, V_{12}, to cut this transistor off. Also peaks obtained from the transmitter timing multivibrator (point "X") are connected through S_2 and CR_4 to the base of the left-hand transistor, V_{11}, to cut this transistor off. When a *p-n-p* transistor is cut off, its collector voltage falls toward the highly negative voltage of the supply. When the transistor is conducting heavily, its collector voltage becomes less negative (rises in a positive direction) toward ground potential.

The positive peak at the beginning of the transmitted pulse resets the metering multivibrator by cutting off V_{12} and driving V_{11} into conduction. The collector voltage of V_{12} thus goes very negative. At the end of the transmitted pulse, the positive peak from point "X" cuts off V_{11} and drives V_{12} into conduction. The collector voltage of V_{12} thus rises in a positive direction toward ground. This is the beginning of the positive-going meter-gating pulse. When an echo comes in, the positive peak derived from the echo cuts off V_{12} and drives V_{11} into conduction. Now the collector voltage of V_{12} drops back to its original highly negative value. This action terminates the positive-going meter pulse. A positive gate is, therefore, generated at the collector of the right-hand transistor whose length is equal to the time period from the trailing edge of the transmitted pulse to the start of the echo pulse.

This positive gate width is utilized for metering by a microammeter. The greater the time delay of the echo, the wider the meter-gating pulse and the greater the meter deflection. The meter deflection *versus* gate length was found to be quite linear so that the meter scale may be used directly as a calibration in feet of depth.

It is interesting to note that if S_3 is momentarily opened, C_{12} is not cut off but continues to conduct heavily. Under these conditions, the meter can be adjusted to read full scale (100 μa. or 100 feet). If switch S_2 is momentarily opened, V_{12} remains cut off. Now the meter can be adjusted to read 0 μa. or 0 feet.

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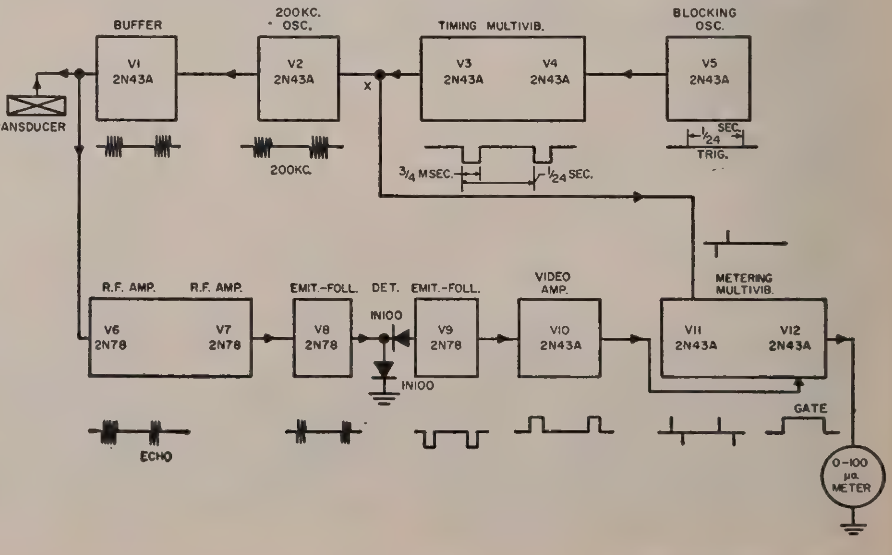
Fig. 4. Over-all block diagram and waveforms illustrating the circuit operation.



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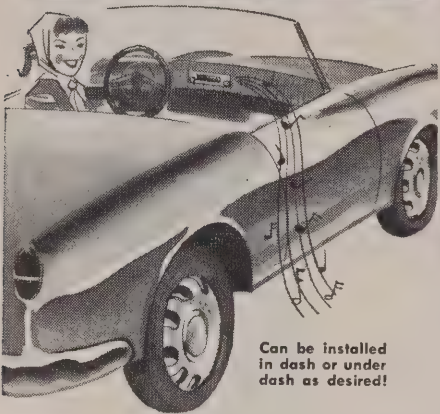
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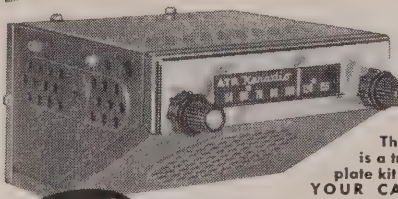

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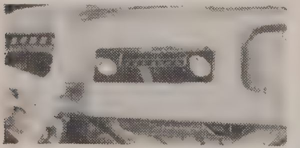


ATR KARADIO . . . is ideal for small import cars or compact American cars! Unit is completely self-contained—extremely compact! Can be mounted in-dash or under-dash—wherever space permits! For 6 volt or 12 volt!

SEE YOUR JOBBER OR WRITE FACTORY

• "A" Battery Eliminators • DC-AC Inverters • Auto Radio Vibrators

ATR
AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA, U. S. A.

piece of plastic over the meter for protection. On the underside of this unit is a small plastic sponge saturated with liquid "Lux." To put the unit in operation, it is necessary to dip the corner of this sponge in water and coat the face of the transducer. This is to assure a good contact with the water. This is necessary since if there is any air between this face and the water, sound will be greatly attenuated.

Adjustments

Once the unit has been built and installed, the adjustments must be made. The zero switch (S_2) is temporarily opened and the zero-adjust pot (R_{31}) is adjusted for exactly zero meter reading. Then the full-scale switch (S_3) is opened and the full-scale adjust pot (R_{41}) is set for accurate full-scale reading. These adjustments should be made with the transducer in the water otherwise a continuous full-scale reading will be obtained. Next, the unit should be taken out into deep water and L_1, L_2, and C_{17} should be adjusted for maximum sensitivity. This may be done by connecting a scope or v.t.v.m. beyond the receiver detector (V_9 emitter or V_{10} collector) and making the adjustments for maximum pulse amplitude as observed on the scope or maximum v.t.v.m. reading.

The author has built several of these depth meters for himself and for his friends and he has found that the performance of the unit is well worth the time and effort that went into its design and construction. —30—

Mac's Service Shop

(*Continued from page* 64)

ange juice for transport to England. Shrimp boats, yachts, and every other imaginable craft criss-cross the harbor. Flotillas of pelicans ride the waves beside your boat patiently waiting for you to toss them an unwanted amberjack or sailor's choice. A tantalizing odor of scorched orange peeling drifts across from the citrus plant where the waste material is being converted into cattle feed by a heat process. And all the while against the distant horizon stand the slim silhouettes of the gantries beside the missile launching pads."

"Sounds like you had a real ball," Barney observed enviously. "Didn't you even think of poor old Mac and me slaving away back here?"

"I certainly did think of you," Matilda replied quickly; "and I wished 'you were here,' especially when my car radio conked out on the way down. Do you know we lost two-thirds of a day and drove literally dozens of miles out of our way before we got that radio fixed? And all that was the matter was a bad i.f. tube. Most technicians wouldn't look at it when we said we wanted it repaired immediately. Finally we located a shop that advertised 'Auto Radios Repaired While You Wait,' and the man there had it going in fifteen minutes. He charged about half again as much as *you* would for the same job, but we were tickled to pay it for the fast service.

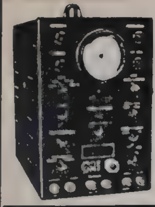
"Sylvia and I both noticed we could have had car trouble taken care of almost anywhere. Many of the larger filling stations advertised that a mechanic was on duty at all times. But you could have counted the highway signs for radio repair we saw on the fingers of one hand. I think someone's missing a good bet."

"You're probably right," Mac agreed. "Most people on a trip want their radio working, and they're willing to pay for fast service. A 'tourist' parts with five dollars a lot more readily than the same guy parts with a buck back home. If a good car radio man had a location on a main tourist artery, it would doubtless pay him to specialize in fast auto radio service and advertise this fact well for a couple of hundred miles in all directions. He could also do quite a business on the side in portable radio repairs and supplies, too."

"Yeah," Barney added, "and if he were located near a heavy concentration of motels, like say around Huntsville, Alabama, he could work out a deal with the motel managers where they could direct ailing car-radios his way. Time is important when you're on the road, and anything that saves time is appealing. I know we're always looking for motels where we can sleep, eat, and have the car serviced all at the same stop. Being able to have a sick radio fixed while the owner slept would be an added inducement. Of course, that means putting on a nightman; but I'll bet it would be a good investment. While he wasn't working on hot-shot jobs, he could keep busy doing regular service."

"I might add," Matilda chimed in as she stood up and started folding the tablecloth, "that several of the shops we stopped at left a lot to be desired appearance-wise. Dirty windows and a dusty, fly-specked window display give a poor impression of a service shop, no matter how good the technician is. If you boys thought I was a nut on the subject of cleanliness and neatness before, be warned I'm going to be twice as cranky from now on. There's nothing like a trip to acquire new ideas and to let you see your own place as it really is. While I know for certain this shop is more inviting than nine out of ten I saw along the road, there's still room for improvement."

"Oh my aching back!" Barney sighed as he put a finger beneath Matilda's chin and tilted her face up to his; "how can anyone look so soft and charming and sound so tough! I always thought electrical shock was the big danger in this business, but now I know that housemaid's knee and detergent hands are the real occupational hazards in a real good service shop—like the one Tildy runs here." —30—



AIRBORNE RADAR INDICATOR ID-93/APG-13

Frequency range 2780 to 2820 Mc. Input power required: 265 Watts from AC supply 120V at 380 to 1600 cycles. Easily converted for 60 cycles. Controls: Horizontal, Vertical, Intensity, Focus, Slope, Marker Amp. Receiver Gain, Yards Range. Tubes used: 6-6SN7GT, 504G, VR105, 2-6H6GT, 2X2, 5V3GT and 3-inch scope tube type 3BP1. Made by G.E. Supplied complete with all tubes, scope tube, and visor. **BRAND NEW. OUR LOW PRICE** **$22.50**

MN26Y BENDIX DIRECTION FINDER

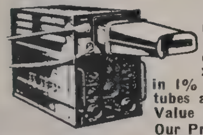
150-325 Kc; 325-695 Kc; 3-4.7 Mc. Complete with tubes, motor.
BRAND NEW **$26.95**

BENDIX DIRECTION FINDER

For commercial navigation on boats and planes. 150-1500 Kc. continuous.

MN-26-C Receiver, used, with 12 tubes.. **$18.95**
MN-26-C With 12 Tubes, BRAND NEW......$27.50
MN-20-E Rotatable Loop.................. 4.25
MN-52 Azimuth Control Box............... 2.95
All necessary accessories for above in stock.

LORAN R-65/APN-9 RECEIVER & INDICATOR



Used in ships and aircraft. Determines position by radio signals from known xmitters. Accurate to within 1% of distance. Complete with tubes and crystal. Exc. used.
Value $1200.00.
Our Price.......... **$79.50**

MOBILE-MARINE DYNAMOTOR

Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs.
OUR LOW PRICE... **$6.45**

OTHER DYNAMOTOR VALUES: Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.75
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.25
DM-53A	28V 1.4A	220V .080A	3.75	5.45
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	7.95	10.50
PE-86	28V 1.25A	250V .050A	2.75	4.95

DYNAMIC BOOM MIKE M-33/AIC. Low impedance. With mounting bracket for attachment to headsets. A REAL VALUE at $3.95

DYNAMIC HANDMIKE, with "Press-to-talk" Switch on handle, cord and plug—BRAND NEW, only........$2.95

DYNAMIC HANDMIKE, aircraft, made by Telephonics Corp. Press-to-talk switch on mike. BRAND NEW.......$4.95

Hi-Fi DYNAMIC HEADSET with Cushions

Freq. Range: 40-14000 CPS. No Distortion.
BRAND NEW **$7.85**

MICROPHONES

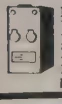
Model	Description	Excellent Used	BRAND NEW
T-17	...Carbon Hand Mike....	$4.75...	$6.95
T-30	...Carbon Throat Mike...	.34...	.74
T-45	...Army and Navy Lip Mike.......		1.25
T-24	...Carbon Mike..................		5.95
TS-9	...Handset		3.88
RS-38	..Navy Type..........	2.69...	4.75

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	..High Impedance......	$2.19...	$4.65
HS-33	..Low Impedance......	2.69...	4.65
HS-30	..Low Imp. (featherwt.).	1.15...	1.89
H-16/U	.High Imp. (2 units)...	3.75...	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS. BRAND NEW, PER PAIR $3.25
CD-307A Cords, with PL55 plug and JK26 Jack .... .99
Earphone Cushions for above—pair...... .50

REMOTE CONTROL RM-52



Direct remote control for radio equipment. Uses 4 flashlight batts. Provides bias for Microphone and sidetone to headset. Hi or Lo imp., Mike and Phone jacks. Makes good phone patch unit.
BRAND NEW.................. **$2.49**

MIDGET FAN MOTOR

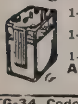
1⅜" square x 2" long, ⅛" shaft extends ½". 10,000 RPM. 24V DC. Input. Complete with fan...... **$2.19**

FL-5 FILTER..79¢
FL8 Filter $2.45

WILLARD 6-VOLT MIDGET STORAGE BATTERY

8 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte..............Only $2.69

2 VOLT BATTERY "PACKAGE"



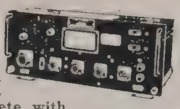
1—2V. 20 Amp. Hr. Willard Storage Battery $2.79
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells).. 1.45
ALL BRAND NEW!
Combination Price **$5.45**

TG-34 Code Keyer, Like New..................$16.88

SCHEMATIC DIAGRAMS For any equipment on this page, each.. **65c**

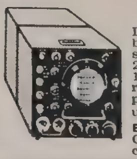
SEND FOR FREE CATALOG, many more Wonderful Surplus Buys!

FM TRANSMITTER-RECEIVER



APN-1. 420 to 460 Mc Aircraft Radio altimeter equipment. Tubes: 4—955, 3—12SJ7, 4—12SH7, 2—12H6, 1—VR150. Complete with all tubes and mount. For 27 V DC.
BRAND NEW........................ **$8.95**
Original operating manual for above......$1.00

BC-929 3-INCH SCOPE



Low cost station monitor and/or bench scope. Has Horiz., focus, sweep, intensity controls. Tubes: 2—6SN7, 2—6H6, 1—6X5, 1—6G6, 1—2X2, 3BP1 CR Tube. Voltage req. 115V 400 cy. and 24VDC. Complete with tubes, exc. used **$9.95**
BRAND NEW $12.95
Conversion instructions for 110V 60 cyc AC ....65¢

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case.
COMBINATION..................Special **$32.32**

Receiver only, with all tubes...............$19.50
Transmitter Only, with all tubes...........$22.25
Accessories for above available.

BC-312 RADIO RECEIVER FOR VEHICLES

6 Bands 1500 KC to 18 Mc. continuous tuning. Phone and CW, internal dynamotor. Swell ham mobile receiver very clean, diagram included. Complete with Tubes and 14 V Dynamotor. Exc. Used........... **$49.50**

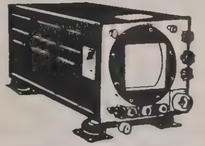
BC-312 AC Model, with 110 V AC Power Supply RA20 ....$59.50

AN/ARC-1 Airborne radiophone ground to plane Rcvr-Xmitter. 10-channel xtal controlled, easily converted to 20 or 50 channel, VHF 100 to 156 Mc AM. Complete with tubes, mtg rack, dynamotor. OUR LOW PRICE Exc. **$79.50**

AN/APR-4 RECEIVER only. 38 to 4000 Mc in 5 tuning unit ranges. High precision laboratory instrument used to monitor or indicate frequency of any signals within its range. Includes wide and narrow band IF strip selected from panel. Outputs provided for attachments to pulse analyzer, panadapter, etc. Input 115 V 60 cy. LIKE NEW **$69.50**
Tuning Units: TU16, TU17, TU18.each $39.50
TU19 ....each $89.50

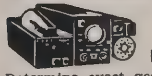
AN/ARN-5A AIRCRAFT RECEIVER. 11 tube superhet, 3-crystal control UHF for static-free reception.
Exc. used with tubes........... **$16.95**
BRAND NEW $19.95

ASB-5 'SCOPE INDICATOR



BRAND NEW, including all tubes, together with 5BP1 'Scope Tube. Originally used in Navy Aircraft RADAR equipment. Easily converted for AC operation.
VALUE $250.00!
OUR LOW PRICE .. **$15.95**

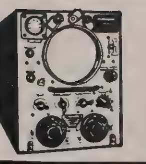
LORAN APN-4



FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.
INDICATOR ID-6B/APN-4, and RECEIVER R-9B/APN-4, complete with tubes. Exc. used **$42.50**
Receiver-Indicator as above, BRAND NEW..**$59.50**
Complete Kit of Accessories for Above: PE-206 Inverter, Set of Plugs, Visor for Indicator, Operation Manual, ALL BRAND NEW...... **$49.50**

LORAN APN/4 OSCILLOSCOPE



Easily converted for use on radio-TV service bench.

Completely Assembled

LIKE NEW! Supplied with 5" Scope, type 5CPI only **$14.95**
Brand New $19.50

BC-603 FM Receiver, 20-28 MC, complete with tubes $16.50

AC POWER SUPPLY FOR BC603, 683

Interchangeable, replaces dynamotor. Has On-Off Switch. NO RECVR. CHANGE NEEDED. Provides 220VDC @ 80 Ma. 24VAC @ 2 Amps.
Complete kit, with easy instructions... **$8.45**
Wired $10.49
Complete 240-page Technical Manual for BC-603, 604 ....$2.95

Please include 25% Deposit with order—Balance C.O.D. 50¢ Handling Charges on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

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AN/ART-13 100-WATT XMTR

11 CHANNELS
200-1500 Kc
2 to 18.1 Mc

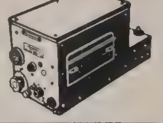
$48.50 **Complete with Tubes**

Famous Collins Autotune Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier/clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xtal controlled calibrator. PP811s modulate 813 in final up to 90%, class "B." A Real "HOT" Ham buy at our low price! Orig. cost $1800.
Exc. Used........................ **$48.50**
0-16 Low Freq. Osc. Coil for ART-13.... 7.95
24V Dynamotor for ART-13........... 11.95

ARB Receiver 4 band 195-9050 Kc, with all Tubes, Like New.......................... **$17.95**
Brand New, with Tubes and Dynamotor........$34.50

234-258 MC RECEIVER

AN/ARR-2



BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price!
Complete with tubes **$8.88**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC......	$14.50	$16.50
BC-454	Receiver 3-6 Mc..........	9.45	12.45
BC-455	Receiver 6-9 Mc..........	10.45	12.45
BC-450	3-Receiver Control Box.....	1.29	1.75

110 Volt AC Power Supply Kit, for all 274-N and ARC-5 Receivers. Complete with metal case, instructions...... **$7.95**
Factory wired, tested, ready to operate $11.50

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. **Only**.......................... **49c**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.85**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal.
BRAND NEW **$7.85**
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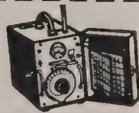
BRAND NEW **$12.75**
ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.85**
BC-456 Modulator ....**USED** 3.45 **NEW** 5.95
BC-451 Transmitter Control Box.. 1.25 **NEW** 1.49
POWER SUPPLY KIT, for All Command Transmitters. Provides all needed voltages.
A quality kit, only.................. **$29.50**

BC-906 FREQ. METER—SPECIAL



Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included.
OUR LOW PRICE............ **$9.88**

STANDARD TUBES

Removed From Brand New Govt Equipment

1S5	.35	6AJ5	.45	6X5	.35	807	.95
3Q4	.35	6AK5	.35	6E5	.35	813	6.95
6AG5	.35	6C4	.25	6AC7	.55	826	.44
12AT7	.45	6X4	.32	6J6	.32	5670	.75
12X4	.35	6AL5	.33	6BA6	.35	1625	.29
12AX5	.45	6J4	.59	6AS6	.55	1629	.29

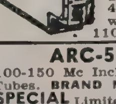
MINIMUM TUBE ORDER: 6 TUBES (6 of a number or 6 assorted).

BC-620 FM TRANSCEIVER, 20-28 Mc. BRAND NEW. Complete with tubes..... **$12.95**

BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Exc. Used............ **$11.95**
BC659 Vibrator Power Supply, exc. used.........$6.95
Brand New $9.95

ARC-5/R28 RECEIVER



2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. **BRAND NEW** **$24.45**
110V AC Power Sup. Kit for above $9.75

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. **BRAND NEW**.................. **$21.50**
SPECIAL OFFER! Limited quantity ARC-5/T23 xmitters. Excellent Used, less tubes.........$5.95
MD-7 MODULATOR for T-23, complete with 4 tubes. LIKE NEW.................. **$9.95**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes...... **$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**
MODULATOR for above, new with tubes.....$5.95

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NEW STEREO RECEIVER

NO ONE BUT BOGEN, builder of over one million high-fidelity and sound-distribution components, could have engineered the new SRB 20 stereo receiver. A superb all-in-one instrument, it's a highly sensitive FM-AM stereo tuner, a versatile audio control center, a magnificent 20 watt (10 per channel) stereo amplifier, and it's *only $199.50*—a price you'd expect to pay for a comparable tuner alone!

YEARS AHEAD. Bogen's engineering staff (largest of any sound-equipment maker) has designed the SRB 20 to be years ahead in performance as well as price. Here is all the flexibility...all the distortion-free tone quality...all the power you need for perfect stereo pleasure. Reflecting over 25 years of experience gained in building specialized sound systems for schools, theatres, industrial plants and offices, in addition to high fidelity components, the SRB 20 provides the faithful sound reproduction listeners have learned to expect from Bogen. Enjoy the beautifully styled SRB 20 yourself or install it for your customers—either way you get the best buy in hi-fi today!

BOGEN SRB 20 STEREO RECEIVER

CONTROLS: Selector. FM Tuning. AM Tuning. Separate Bass and Treble for each channel (lock for simultaneous control of both). Volume for each channel (correct imbalance, then lock for simultaneous control). On-Off Power. FM On-Off and AFC out. AM On-Off and Multiplex.

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Please send me illustrated booklet, "Understanding High Fidelity." 64-page explanation of hi-fi and stereo. Enclosed is 25c.

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CERTIFIED RECORD REVUE

By
BERT WHYTE

THIS month I want to expand further a subject which I wrote about some time ago. You may recall that I gave a dissertation on record criticism, in which I pointed out that there were many factors entering into the production of a recording which are not as much under the control of the recording company as one might think. I pointed out that, especially in this stereophonic era, there are certain compromises which must be made in the production of a record, which will affect its balance, level, dynamics, and many other things. I suppose there are not many people, including record critics, who realize just how "compromising" the record business can be. I do not say this, nor mean to infer, that I was cognizant of these compromises. Nor do I wish to imply that I have any special "license" to carp at my fellow critics. However, as has been said many times, nothing teaches like experience and having been recently involved in the production of some stereophonic recordings, I think I can say with a certain degree of knowledge, that far too many critics today are passing judgment on records and making statements which are almost totally irresponsible.

In view of this production experience of mine, I have come to the conclusion that if a critic is to be truly informative about a recording, it is almost mandatory that he spend some time, even if it is only a few days, with a professional recording company, preferably under the guidance of the Director of Artists and Repertoire. Only in this way will the critic begin to appreciate the incredible complexity that is part of making a recording.

In almost every department of the record company involved with disc production, he will learn the many reasons why a recording is issued in a given way. He will begin to appreciate the tyranny of time which, like an ominous shadow, hovers over a great deal of record production. The critic will be told that on a stereophonic disc he may not exceed 25 minutes of music on a 12″ side, because even with the most advanced of today's stereo cutterheads, to go beyond this point imposes the penalty of reduced volume levels and/or dynamic range. He will learn that in today's highly competitive record market, no responsible company would risk issuing a stereo disc which is appreciably reduced in level and dynamics.

By this time our critic friend may have come to the sad realization that, unfortunately, composers didn't write music to fit the confines of a 25-minute time segment on a 12-inch vinylite disc. He will share the dilemma of the A.&R. director when he is faced by a piece of music which happens to be 53 minutes long. He, too, can wrestle with the problem of how to get this much music on a disc which can accept only 50 minutes of music while maintaining the highest quality. The problem may be further compounded by the fact that this piece of music is in four movements, the first two movements of which happen to be 29 minutes long and the last two 24 minutes. Now it is obvious that the 24-minute segment will fit into the arbitrary 25-minutes-per-side. It's just as obvious that the 29-minute segment will not fit. Now, if he tries to subtract 5 minutes from the 29-minute segment, thus making it fit the first side of the disc, he then winds up with five minutes of music which he must add to the second side, which once again becomes an impossible 29 minutes. Thus the trouble begins and gives rise to the conditions with which an uninformed critic can find many faults. This critic rages at the A.&R. man and the company for what he considers "unnecessarily" breaking into a movement.

Now our poor A.&R. man hasn't solved his problem yet. He's faced with the fact that both the company and the conductor want to issue this particular 53-minute piece of music. Where does he go from here? Two-disc sets are commercially unpopular and, in any case, then the piece would be too short and it would become necessary to record some other piece in order to fill a two-disc album. Well, the company balks at this and so the A.&R. man and the conductor consult scores, manuscripts, and musicological texts, hoping they will find some reasonably valid excuse or precedent for making a small cut in the score, probably by eliminating some repeats and thus saving the day.

Let us consider another case where a piece of music is 26½ minutes long. This is a real temptation in that it almost fits and so for the sake of the recording, the quality bars are let down in regards to level and dynamics but the 26½ minutes goes on the one side. However, if company policy is such that they refuse to compromise quality, then there may be more learned conferences between A.&R. and conductor and this time they are looking for excuses or precedents or interpretations of tempo markings, which will enable them to reduce the time of the work by that precious 1½ minutes and therefore solve the problem.

I could give many other examples of this heartbreaking time situation, but suffice to say the end result of all of these problems may be success in fitting the music to the disc but at the risk of incurring critical wrath. For all the critic knows is that a "cut" was made in the *andante*, the tempo in the *largo* is much too fast, it was stupid of the company to cut into the second movement where they did and begin on the other side, don't these fool companies know that the second and third movements of the Schumann Piano Concerto are played together without a break, etc., etc. So you can see from the foregoing, that there are many, many problems in record production of which most critics are blissfully unaware, but which, if they are to give intelligent and fair critiques must be taken into account. Thus it behooves the honest critic to acquire knowledge along these lines, so that when he gives his review of a disc, he will understand these things and not arbitrarily make vicious and damaging statements about any given company and the products they produce when such attacks are totally unwarranted.

BRAHMS
CONCERTO FOR VIOLIN AND ORCHESTRA

Jascha Heifetz, violinist with Chicago Symphony Orchestra conducted by Fritz Reiner. Victor Stereo L.S.C. 1903. Price $5.95.

This recording originally appeared in the stereo format on tape and was very warmly received by most critics. Certainly in the brilliant and sweeping interpretation afforded the work by Heifetz and the sympathetic accompaniment of Reiner, this is one of the most satisfactory and memorable recordings of this wonderful Concerto. Now, transferred to stereo disc, it should gain many more new admirers, both for the splendid performance as well as for the excellent stereo sound qualities.

This was originally a two-track recording and, although there is some "hole-in-the-middle" apparent, it is remarkably well done with excellent directionality, good balance between the soloist and orchestra, and with the superb Orchestra Hall acoustics there is a fine pervasive sense of depth that adds considerably to the over-all realism. The disc stands comparison very well with the tape, except in the matter of dynamics where the nod goes to the tape.

BEETHOVEN
SYMPHONY #1
SYMPHONY #8

Philharmonia Orchestra conducted by Otto Klemperer. Angel Mono 35657. Price $5.95.

In the space of relatively few years, Otto Klemperer has built up a formidable reputation as a Beethoven specialist. Especially is this true in England where he is treated with a reverence once accorded Toscanini. There are more than a few people who feel that this adulation is nothing but a pose and that his interpretations are so highly regarded simply because it is "fashionable" or "the thing to do." It is unfortunate that any artist must work under such a handicap, even though there may be a certain validity in these attitudes. Despite this, Klemperer has managed to consolidate his position with the musical cognoscenti, because he has given Beethoven performances which are unquestionably masterful. One thinks immediately of his magnificent "Eroica" and the "Seventh Symphony."

I have prefaced this review with these remarks anent the Klemperer reputation, because this recording is, in many ways, a reflection of current attitudes—which is to say that in both the "First" and the "Eighth" symphonies, Klemperer stays strictly within the bounds of the scores and there is certainly no evidence of conductorial "interpretation."

Each note is as the score demands, the tempi are correct and these would seem prime examples of Beethoven exactitude. This may have a great appeal for many people, especially musicologists, but as far as I am concerned, Klemperer falls short of the mark in this recording. Of all the Beethoven symphonies the "First" and the "Eighth" are the mostly lightly scored and have a certain

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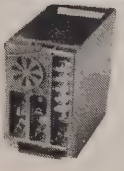

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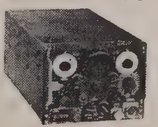

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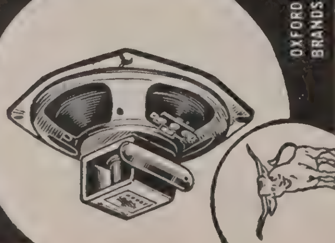

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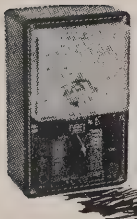

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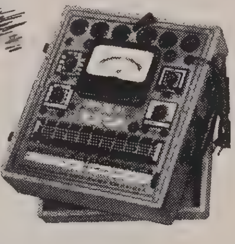

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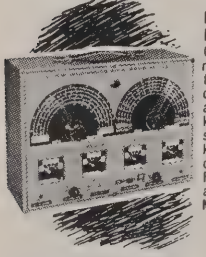

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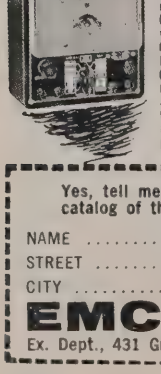

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charming delicacy that cannot abide heavy-handedness. Note-perfect Klemperer may be, but in these straightforward readings there seems to be a singular lack of humor and a lack of feeling for the essentially buoyant nature of the works. It might appear that Klemperer, while admirably suited for the heavier, more dramatic type of Beethoven, is just a shade too inflexible with this type of material.

As regards the recording, it is a fairly well balanced job, with nice clean strings and especially pure-toned woodwinds. All is enrobed in broad spacious acoustics, which while lending a pleasing roundness to the sound, is also the type of sound that can least stand a heavy-handed performance. I have not heard this recording in the stereo format, but have an idea that when I do, there will be a gain in instrumental clarity and definition that will help to "lighten" the over-all impression of the sound. For those for whom Klemperer can do no wrong, I can guarantee a very smooth recording in the typical *Angel* manner.

MOZART
PIANO CONCERTOS #11, #20

Rudolf Serkin, pianist with Marlborough Festival Orchestra conducted by Alexander Schneider. Columbia Stereo MS 6049. Price $5.95.

As might be expected in this stereo age, those artists who are famous for certain interpretations are busily engaged in recording them anew for stereo discs. Such is the case with Rudolf Serkin and these two Mozart Piano Concertos. In their monaural format, these have been among the most widely acclaimed of Serkin's entire recorded output—and rightly so, for they are miracles of transcendently beautiful piano playing. These are performances which have all the elan and grace and delicacy of approach too often missing in the readings of other less discerning artists.

Although #11 and #20 are opposed in temperament, both still demand the discipline of playing in which heavy-handedness has no place. One could dwell at length on Serkin's techniques, but more important is his very positive expression which, above all, conveys the real warmth and depth of his performances. I have no knowledge of the Marlborough Festival Orchestra, there being so many festivals these days that one is hard put to keep up with them. Suffice to say, it is a reasonably competent and musicianly group which plays well under the baton of Alexander Schneider. The ubiquitous Schneider seems to crop up at festivals everywhere and, as usual, displays his excellent talents for conducting and, in particular, his ability as an accompanist.

The recorded sound here is, in general, excellent except for a certain hardness of tone which occasionally marred the piano sound and a slight "wiriness" in the string sections. Stereo effects were well-maintained, with good directionality and with the piano well centered and remaining in that position throughout the recording. For Mozart lovers, this is a "must."

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Philippe Entremet, pianist. Columbia Mono ML 5366. Price $4.98.

More piano, this time by up and coming Philippe Entremet, who certainly qualifies as one of the most promising of the younger echelon of pianists. He could scarcely have chosen a better display case for his talents than the fiendishly difficult "Pictures at an Exhibition." Although many are more familiar with this work in its orchestral transcriptions, it was, of course, originally scored for piano and for many years has been one of the most exacting and demanding works for solo piano. Entremet shows very clearly a firm grasp of what is expected pianistically, in this score. He has a most facile technique, coupled with a keen insight into the complexities of the score. His phrasing is particularly expressive and his dynamic shadings have very wide compass. He has given us an over-all performance which can stand on its own feet with the performances of many more mature artists.

In the Ravel pieces he is, of course, bucking the formidable talents of such men as Casadesus and Gieseking. It is to his credit that he compares most favorably, although still lacking the finesse and warmth which are so typical of the playing of these more mature artists.

The piano is miked fairly close-up and gives us plenty of detail without exaggerating some of the mechanical sounds which are often produced in this type of recording. By clothing it in rather broad acoustics, we have a very good piano sound which is round and warm enough for the more lyrical sections and yet does not obscure details in the sections where this is of paramount importance. On the basis of this recording, one must pay close attention to the Entremet career, for he has the almost certain promise of developing into a major artist.

DVORAK
CONCERTO FOR VIOLIN AND ORCHESTRA
GLAZOUNOV
CONCERTO FOR VIOLIN AND ORCHESTRA

Nathan Milstein, violinist with Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol Stereo SP 8382. Price $5.95.

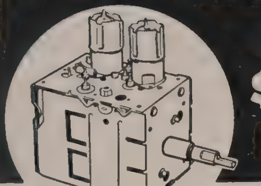
As with other companies, *Capitol* is beginning to transfer many of its stereo tapes to stereo discs. This particular recording enjoyed great success in the tape format and there is no reason to believe it will fare any differently as a disc. The success of this record can be attributed to the wonderfully expressive performances of Milstein and the fine rapport which exists between himself and Steinberg.

In matters of sound, this was one of the best examples extant of the violin concerto in stereo, with all the attributes of directionality, positioning, and depth in full abundance. The over-all sound is exceptionally clean and undistorted and Milstein's violin is reproduced with great exactitude, but not at the expense of a very full, richly resonant tone. The two pieces are most certainly a part of the classical repertoire for violin and yet one hears them rarely and most people are more familiar with such staples as the concertos of Brahms, Tchaikovsky, Mendelssohn, etc. It is suggested that lovers of the violin concerto, whose appetites are somewhat jaded by too much of the above-mentioned, will find both these works quite lyrical and most interesting in their own right.

ROSSINI-RESPIGHI
LA BOUTIQUE FANTASQUE
IBERT
DIVERTISSEMENT

Boston Pops Orchestra conducted by Arthur Fiedler. Victor Stereo L.S.C. 2084. Price $5.95.

This is still another transfer from stereo tape to stereo disc, and I suppose this sort of thing will be going on for some time. It probably makes for a certain amount of redundancy and risk of repetition, but since there are so many more people equipped for



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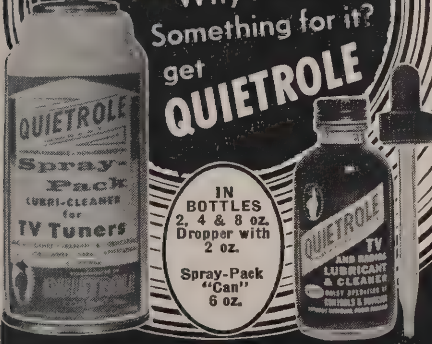

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stereo disc, who were not heretofore in the stereo market, it would be doing them a disservice not to report on these recordings.

With the frothy almost insubstantial repertoire on this record, Fiedler is at his fabulous best. His reading of the "Boutique Fantasque" respects the balletic nature of the work and captures the essential charm and grace of the score. The Ibert piece is a wonderful tongue-in-the-cheek parody on a number of other musical works and throughout there are musical quotes from these scores which are, to say the least, hilariously funny. The treatment that Ibert gives the "Wedding March" is almost rude, but will be appreciated by anyone with a good sense of humor.

I have been meaning to get around to telling you about what I consider one of the very best values in records today. This is the new *Richmond* label, which is a subsidiary label of *London Records. London,* one of the most active companies in the stereo field, is busily engaged in a vast project of re-recording all of its releases which have enjoyed any considerable degree of commercial success.

As is well known in hi-fi circles, *London* has always had a deservedly high reputation for the superb sound qualities of its discs. As a result, even though these are monaural recordings and some of them made as far back as 1950-51, the sound, in most cases, is equal or close to today's standards. There has been a great spate of these *Richmond* releases and I am afraid that it would take up too much space to cover even a small fraction of them. However, there are some really outstanding issues which I am most happy to recommend to those people who have as yet to embrace stereo and who are looking for one of the best buys in recordings. First and foremost must be the world famous recording of Stravinsky's "Petrouchka" as performed by Ernest Ansermet and l'Orchestre de la Suisse Romande on *Richmond* B19015. This was a recording which, in its day, was considered a milestone in high-fidelity recording techniques. This judgment is still valid, for on the hi-fi systems of those days, this recording produced such magnificent orchestral sonorities that it left most enthusiasts gasping. It might be said that with this recording the term "high-fidelity presence" was born. I have long cherished my old *London* version of this disc and can report that the *Richmond* version is, if anything, better than the original!

Among other outstanding *Richmond* issues, notable both for quality of sound and splendor of performance are the following discs which are highly recommended as worthy of your attention: On B19037 can be heard one of the best performances of the Beethoven "Pastorale Symphony" extant, that being by Erich Kleiber and the London Philharmonic Orchestra. On B19010 you can hear the rich sonority of the Amsterdam Concertgebouw under the direction of the late Edouard van Beinum in a brilliant performance of Berlioz' "Symphonie Fantastique" and on B19073 can be heard one of the greatest Strauss conductors of our generation, Clemens Krauss, and his inimitable performances of "Til Eulenspiegel" and "Don Juan," with some impressive sounds coming from the magnificent Vienna Philharmonic Orchestra. These are but a few of the treasures available at $1.98 on the *Richmond* label and it will be worth your while to hear as many of them as you can. —30—

Bert Whyte's column "Sound On Tape" has been omitted in this issue since Mr. Whyte is in Europe on several recording assignments. We hope to continue this column next month.

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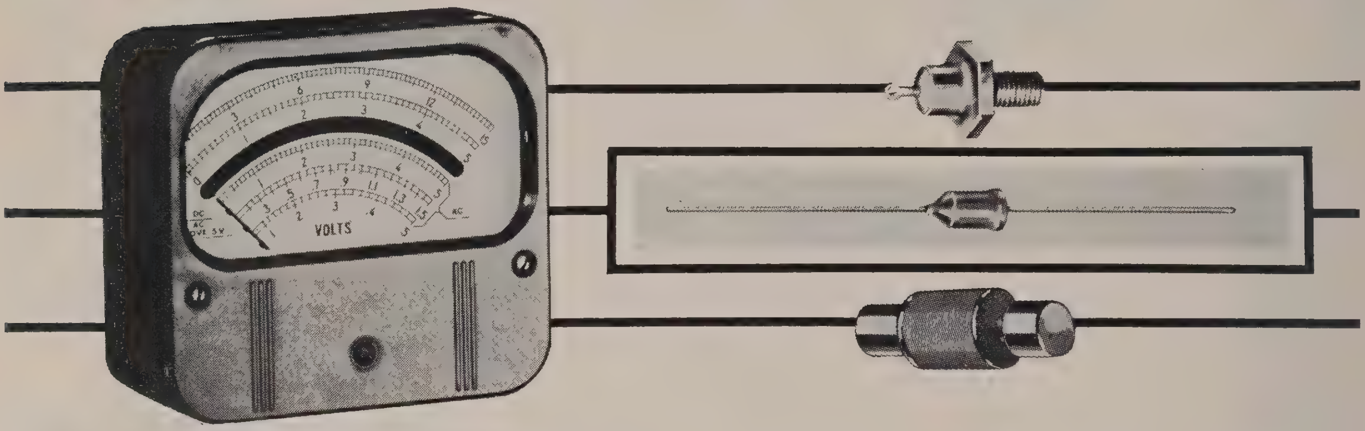


HIGH ON THE technician's list of sounds that sicken is that of a meter pointer slamming against the stop pin. Consider the situation. You have committed an error that has resulted in a healthy whack on an instrument of appreciable cost. Hastily withdrawing the meter prods from the circuit under test, you begin to take stock with several questions.

First, is the meter burned out? Fortunately, this isn't the usual result. Yours—thank goodness—responds to normal current. Second, is the pointer bent? Definitely, but not so much in this case that you can't manage to straighten it out with great care. Third (not to be overlooked after the pointer has been straightened), how's the balance? What with the beating this instrument takes, balance may already have been off before the mishap. So, if you do a good job, knowing what you are about, and you are lucky, the meter may end up better than before. Then, again, it may not.

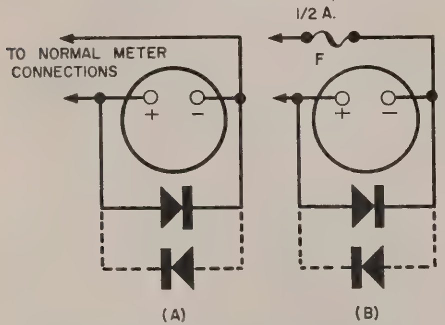
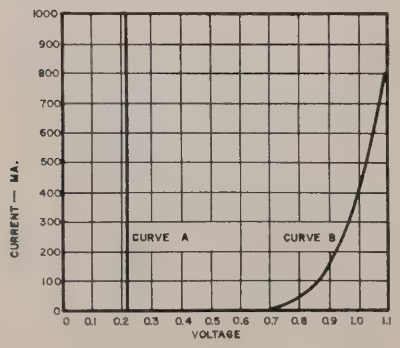


Fig. 1. Hook-ups for the protective diode(s) with and without added fuse.

Fig. 2. Ideal (curve A) and practical (curve B) silicon-diode characteristics.



But why worry about a pound of cure when you can use an ounce of prevention to avoid slamming or at least slow it down to a harmless level? Expensive or complicated, you say? One or two of the relatively new silicon junction diodes will do the trick at a cost that may be no more than slightly over a dollar each, depending on the meter.

The basic circuit, with and without a fuse, is shown in Fig. 1. Addition of the fuse and of the second diode (broken lines) will be discussed later. Resistance of the diode (or diodes) is so much higher than that of the meter, under normal use conditions, that accuracy is not impaired. Under a forward overload (arrow-head terminal positive) however, the nonlinear diode's resistance drops so sharply that most of the excess current bypasses around the meter. Moreover this low shunt resistance damps the movement, thus slowing down the pointer's speed, as well as its extent of deflection.

The notion of protecting meters with this technique is not new, but has probably not been used more widely because the characteristics of available diodes in the past left much to be desired. For the most widely used meters, a diode would have to pass negligible current (say, less than .1 microampere) up to an applied voltage ranging between .02 and .2 volt, and then pass a much higher current beyond this applied voltage. The turning point should lie just above the "FSD" voltage—the voltage required to produce full-scale deflection, or E_{fs}. Ideally, the sharpest bend on this curve should be a right angle, as in curve *A* of Fig. 2.

Let's take a 0-50 microammeter whose internal resistance, R_m, is 2000 ohms. This type is used in many popular v.o.m.'s. The FSD voltage (E_{fs}) is then 50 μa. times 2000 ohms, or .1 volt. A shunt diode that passes no more than .1 μa. at .1 volt will cause a maximum error of .1/50, or .2 per-cent—negligible when compared to the usual accuracy limits of ±2 per-cent.

The solid curve of Fig. 3, typical of present-day silicon junction diodes at room temperature, shows that diode current will stay below .1 μa. up to a point where there is nearly .2 volt across the meter. Thus, at the E_{fs} of our 50-microammeter unit (.1 volt), the shunt effect of the diode will not be enough to cause a flicker of the meter pointer even when the diode is alternately connected and disconnected.

The solid curve of Fig. 3, a semi-log graph, has also been shown as curve *B* of Fig. 2, a linear graph. This was done simply to compare the actual characteristics of an available diode with the ideal characteristic desired. In practice, Fig. 3 is more useful than curve *B* of Fig. 2, because the former shows what happens in that important region where .6 volt or less is applied across the meter. The broken line of Fig. 3 simply shows that the solid curve approximates a straight line, for the most part. Assumption of such a straight line simplifies the development of formulas for determining diode behavior, under specific conditions, that will be accurate enough for most purposes. For example, the effective resistance of the diode is not fixed, but varies with voltage and current conditions. A formula for determining this dynamic resistance characteristic and its specific value at a given point on the curve is easier to develop and to work with when the straight line is assumed.

Calculations and the graphs reproduced here will show that the diode's decrease in resistance as current increases is quite rapid. For example, as the voltage across our diode-shunted sample microammeter rises to 1 volt, diode resistance drops well under .1 ohm. Almost a dead short under such an overload, the diode will damp so heavily that whatever pointer slamming might still occur would be too gentle to produce damage.

To test the effectiveness of the recommended protection, the author hooked up the circuit shown in Fig. 4. The particular test meter used was a 0-200 μa. unit having a resistance of 1000 ohms, making full-scale deflection voltage E_{fs} equal to .2 volt. The "B" supply shown may be any that will produce at least 170 ma. With S_1 and S_2 closed, R was adjusted so that milliammeter A read 170 ma. Under this condition voltmeter V read only .88 volt, showing that the diode was doing its job of keeping the voltage drop across the test meter way down. (While .88 volt is more than four times as much as the .2 volt that provides full-scale deflection, this is not as serious an overload as one would anticipate. More will be said on this score later.)

S_1 was then opened to remove the "B" supply. With the plastic housing of the meter removed, the latter was placed flat on its back. A small rubber washer, about ⅜ inch in diameter and ⅛ inch thick, was placed just below and to the right of the full-scale mark on the face, where the swinging pointer could hit it. Then S_1 was closed. The pointer hit the washer hard enough to move it about ⅛ inch, a comparatively mild blow that would have done no harm had the stop pin taken the slam instead of the washer.

Next S_2 was opened (removing the protective diode) and R was adjusted so that voltmeter V read 20 volts (as compared to an E_{fs} of .2 volt). This, of course, resulted in a current overload of about 100 times the meter rating. (This sounds worse than it is. The power across the meter was .4 watt, which most meter movements can handle without damage, as will be noted later, aside from the matter of pointer slamming.) S_1 was then opened and the rubber washer was placed in the same position already noted. With S_2 still open to provide no diode protection of the movement, S_1 was closed. This time the pointer knocked the washer clear off the dial onto the worktable surface, a distance of several inches. Had the stop pin taken this slam instead of the rubber washer, the situation would not have been so pleasant.

Next S_1 was opened, the washer was replaced, S_2 was closed to reconnect the protective diode, and S_1 was again closed. The rubber washer barely moved 1/16 inch! The procedure was repeated without the rubber washer, and the meter was checked for pointer bending, balance, and accuracy. There was no evidence of damage.

Aside from the matter of pointer bending, the experiments just discussed raise the question of what happens to the meter movement itself when it is subjected to excessive voltages and currents. Take the typical case of a 0-50 microammeter whose resistance is 2000 ohms. Let us say that as much as 1 volt has been impressed across it—ten times the amount required to produce full-scale deflection. Ohm's Law also shows that 500 μa., or ten times the full-scale current, flows through it. Any good microammeter in use today should be capable of safely dissipating up to .5 watt. Yet Ohm's Law also shows that, with the overload just described, only .0005 watt must be dissipated by the meter. There is a large safety factor here.

Another question arises. What is to prevent the voltage across the meter from rising much higher than 1 volt during a mishap, as when it is inadvertently placed across a "B" supply rated at a few hundred volts? Even with the shunt diode, won't the meter burn out? The answer lies in the fact that the voltage drop across the meter depends on the current through it. The average "B" supply is seldom capable of supplying more than a few hundred ma. on a continuous basis. There is little difficulty in obtaining a silicon diode these days that will handle 500 ma. or more. As curve B of Fig. 2 shows, the voltage across a diode-protected meter will be only a little over 1 volt with 500 ma. and still only 1.1 volt with 800 ma. This has already been shown to be a negligible overload.

How about brief surge currents? Let us say, for example, that the diode-shunted meter is connected across a filter capacitor charged to several hundred volts, capable of producing a brief surge whose peak is several amperes. You might get into trouble here, but the chances are still good. To begin with, the diode might handle this, as some of them can handle surges up to 60 amperes. Furthermore, even if it doesn't, it will "fail safe." That is, instead of opening up, as a fuse would, it breaks down by shorting out. Thus the diode will sacrifice itself to protect the considerably more costly instrument.

However, it is possible to be on the safe side even as far as the diode is concerned. If your meter circuit is such that direct connection across the movement is possible with no protective series resistance, a .5-ampere quick-blow fuse can be placed in series with the parallel meter-diode combination, as shown in Fig. 1B. With 1 ampere across it, this fuse will blow in .1 second; with 2 amperes, it will open in .015 second, and so on. The resistance of a fuse of this rating (about 2 ohms) is normally so low, compared with meter resistance, as to produce no visible error on readings. With some milliammeters, however, meter resistance may be low enough for fuse resistance to merit some consideration.

In many v.o.m.'s using 50-μa. movements, there is a series resistance of 3000 ohms or more on all ranges. Since this is enough to limit surges even on the lowest ranges to tolerable levels, the fuse is hardly necessary.

If a fuse is going to be used to protect the diode, one may ask, why not eliminate the diode altogether and simply use the fuse to protect the meter directly? This approach has its drawbacks. To begin with, while a conventional ½-ampere fuse will suffice to protect the diode, one with a much lower current rating is needed to safeguard the meter directly. The lowest value noted for a fast-blowing instrument fuse, on a check of available catalogues, is 1/500 ampere, or 2 ma. In the case of a 50-μa. meter, this would permit a current overload of 40 times before going to work. Actually, this is not likely to burn out the meter—but the undamped pointer slamming it would permit is best left undescribed. Also, even in a quick-blowing fuse, there is some time lag. This would permit a fairly large current to get through before actual blowing of the fuse occurs.

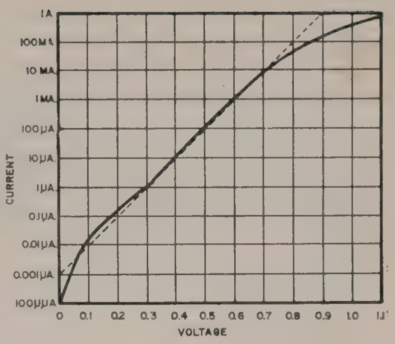


Fig. 3. The same characteristic as curve B, Fig. 1 on a different scale.

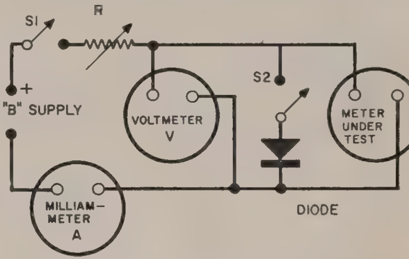
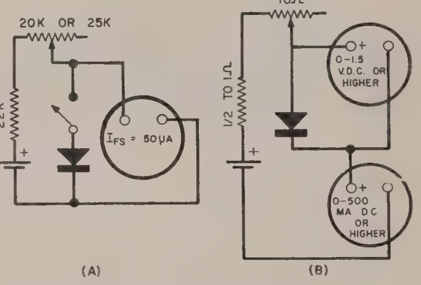


Fig. 4. The test circuit used by the author to confirm the effectiveness of the recommended protective technique.

Fig. 5. Test circuits for checking a silicon rectifier's effect (A) on meter accuracy and (B) during overload.



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As though this weren't enough, remember that the resistance of the fuse itself increases as its current rating goes down. The resistance of a typical 2-ma. fuse is nearly 3500 ohms—enough to upset accuracy in many circuits as compared with the negligible effect of the 2 ohms encountered in a ½-ampere fuse. Add to this the fact that a low-current fuse of the type just mentioned will cost close to a dollar, as compared to the cost of a few cents for the ½-ampere fuse and a cost of not much more than a dollar for many suitable protective diodes. Last, there is the nuisance of replacing the small fuse every time a mishap occurs, whereas the recommended diode-fuse combination will hold up under most overloads. This last consideration can be quite important in practice. Interrupting other work to replace a fuse may make the user feel that the safety measure causes more trouble than it is worth.

The final question: What if the meter is accidentally connected across a circuit with reverse polarity? This is a distinct possibility with instruments that incorporate so convenient a feature as a polarity-reversing switch. The simple answer is to connect two diodes in parallel, but with the polarity of one opposite the polarity of the other, as shown by the broken lines in Fig. 1.

In selecting a diode or rectifier to be used with a particular meter, the first consideration is E_{fs}, the voltage required to provide full-scale deflection. The current sensitivity rating of the meter is almost universally given or available. Meter resistance can be measured directly. From these two, E_{fs} is simple to calculate. If there are any doubts about it, this value can be determined by connecting a variable-voltage source across the meter, adjusting its output upward from minimum until full-scale deflection is reached, and then recording this voltage.

If E_{fs} is about .1 volt or less, almost any good silicon junction diode or silicon rectifier will do, if it is rated at 250 ma. or more at 100° to 150°C. Note that these will handle considerably greater currents at normal temperatures. For example, a typical 1N536, rated at 250 ma. at 150°C, will handle up to 750 ma. at 25°C (77°F). It will also withstand surges up to 15 amperes for a small fraction of a second. This pigtail type is just one of many suitable units made by such manufacturers as *Federal, G-E, Hoffman, Hughes, International Rectifier, Mallory, Pacific Semiconductors, Raytheon, Sarkes Tarzian, Sylvania, Texas Instruments,* and *Transitron*.

In some cases, E_{fs} will exceed .1 volt and be as high as .2 volt, although this will not be usual. Where this is encountered, the choice of available diodes is narrowed somewhat. To maintain meter accuracy, a unit that will pass no more than .1 μa. up to about .2 volt is preferable. One such acceptable example is type 3AS2 (*International Rectifier*).

Although clip-in type silicon rectifiers tend to be somewhat more bulky than pigtail units, some users will prefer them. Typical units are the *Sarkes Tarzian* 10M, 20M, and M500. The last one mentioned has the advantage of being a popular, widely available unit. For compactness, one might prefer rectifiers like the new *Mallory* type "T" line.

The characteristic charts included in manufacturers' literature will generally tell you all you need to know to choose a suitable diode. However, you may have a few silicon diodes already on hand that you would like to try out although you have no literature on them. Checking them is not difficult.

The first step is to check whether the diode will impair meter accuracy, using a circuit like that of Fig. 5A. In this test, the meter shown is the one for which protection is desired. Resistances specified are for a 0-50 microammeter, with a flashlight battery supplying the voltage. The potentiometer is adjusted to provide full-scale reading. Then the switch is alternately opened and closed, putting the diode in and out of the circuit. If manipulating the switch produces no observable change in the meter reading, or the barest pointer flicker at most, the diode has passed its first test, at least at room temperatures.

If you expect to be running into higher temperatures, you can repeat the test after heating the diode. This was done by placing the diode on top of an asbestos pad that was, in turn, placed on the bottom of an upturned electric iron set at its lowest heat, and waiting for the diode to become hot to the touch. (The diode can withstand more heat than this.) Under these unusual conditions, you may have to lower accuracy standards somewhat. However, ordinarily, full-scale reading will still be within 1 per-cent.

To test overload action, an ordinary v.o.m. that will measure at least up to 1.5 volts d.c. and 500 ma. d.c. is needed. If two suitable units are available, the convenient arrangement of Fig. 5B can be used. The battery here should be a storage cell, or four or five flashlight cells connected in parallel, to provide adequate current.

Turn the control arm up until the diode current, as indicated on the milliammeter, reaches the maximum value specified by the manufacturer. This is usually at least 500 ma. at ordinary temperatures. Then read the voltage across the diode with the other meter. This should be about 1 volt—the lower, the better.

If only one v.o.m. is available, hook it up first as a milliammeter in series with the diode, omitting the shunt connection for the voltmeter. After the current has been adjusted, replace the v.o.m. with a jumper, and then use the same v.o.m. as a voltmeter across the diode. We are of course assuming negligible resistance in the milliammeter circuit, usually only a fraction of an ohm when it is set to read 500 ma. or more. —30—

New Third Channel Approach

By NORMAN KRAMER
Asst. Chief Engr., Allied Radio Corp.

Output transformers' secondaries are interconnected in push-pull.

VARIOUS schemes have been devised to correct the "hole-in-the-middle" effect in stereophonic reproduction systems. However, some of these remedial measures require a separate preamplifier with provisions for a mixed output plus an additional "third-channel" power amplifier. Others provide a limited-frequency third channel which may or may not be used in monophonic reproduction because of a complete cancellation of output.

The "Knight-Kit" 40-watt stereo amplifier in *Allied's* 1960 line uses the output transformers in a unique configuration whereby the 4-ohm tap is grounded instead of the common lead. Since the 4-ohm tap, electrically speaking, is the center-tap of the secondary winding, the output transformer is being used as a push-pull output device.

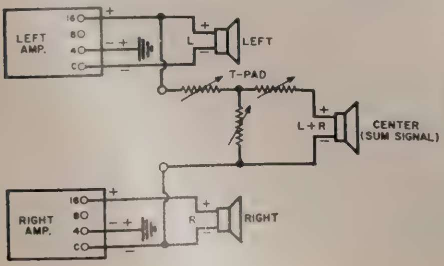
Fig. 1 shows a method whereby the third-channel speaker is connected from the 16-ohm tap on one transformer to the common tap on the other. In this manner a "sum" signal is produced by mixing in the output transformers. Because the mixed signal is derived by summation instead of subtraction, it has the same frequency response as either of the two channels from which it is derived.

It will be further noted that there is absolutely no question of phasing the speaker in the third channel since it derives its phase directly from the other two speakers. This eliminates any problem of objectionable clashing of bass frequencies from the three-speaker system no matter how they might be spaced.

A "T" pad is shown connected across the center speaker because its acoustic output is virtually the same as the other two and need only be set as high as necessary to augment the center fill.

Since the third-channel output is a sum signal, it responds even when the same signal is appearing in both channels and a balanced condition exists. Thus, if the center speaker was located remotely, it would faithfully reproduce program material irrespective of whether the other two speakers were being used for mono or stereo. —30—

Fig. 1. A sum signal produced by mixing in the output transformer. Circuit is used in Allied's "Knight-Kit" stereo amplifier.



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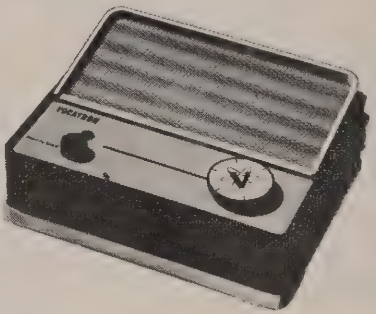

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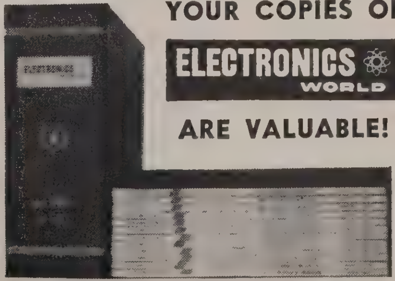

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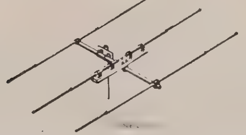

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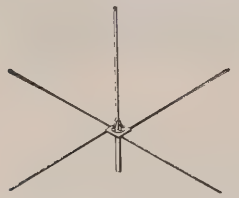

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Safeguard Your Shop

(*Continued from page 65*)

front one are also helpful. These will not stop the skilled professional burglar, but do deter the relative amateur or the vandal whose principal means of gaining entry is simply by smashing a glass somewhere.

Electric alarm systems are, without question, of great value. Unfortunately, the cost of thorough ones is beyond the budget of a smaller radio-TV service business. If one such is out of question, the electronic technician should have little difficulty or expense in setting up some well-placed electric eyes about the shop. They can be wired to set off ringing alarms or to actuate blinking red lights outside the shop, thus providing a clear warning when something is amiss. Inexpensive box cameras with flash guns can also be set off. They are helpful in providing assistance toward the apprehension of invaders and securing proof of guilt. Even when they fail at this, they will help to scare off illegal entrants before much damage is done.

The state of repair of the shop building may also have a great deal to do with vulnerability. Loose boards or bricks in the wrong places may be a temptation for someone to try getting in. If your premises are rented, get after the landlord to make sure that such matters are taken care of promptly.

Locks have already been mentioned, but more should be said. For the difference in cost between good ones and inferior ones, it just doesn't pay to consider the latter. Even with good ones, an occasional check and preventive maintenance is wise. Lubricate your locks every now and then. Powdered graphite or a lubricant using graphite is best in most cases.

The finest lock depends on the key or keys that fit it. Limit the number of keys for each lock to as few people as possible and keep a record of all those in use. When a key is lost, change the lock it opens *immediately*. "Double locking" should be automatic to foil the celluloid strip artists who can manipulate the tongue on the lock which is merely pulled to.

Expensive equipment often makes an impressive window display, but there are many attractive displays that can be worked out without such material. Any merchandise, test equipment, or other gear that has appreciable cash value should be kept *out* of the windows. They are invitations to anyone inclined to hurl a brick through a window, grab something, and run off into the darkness—which can be done before anyone has a chance to react to the incident.

The phone number of the shop owner and of anyone else who has the keys should always be posted on the inside glass of the front door or some other prominent place. This helps police get quicker action if something should happen, despite precautions. This advantage in time is often the difference between apprehension of the criminal, with recovery of what he has stolen, and a total loss. Posting the phone numbers prominently will also encourage a passerby to call if he should happen to see something suspicious while you are away.

In general, the recommendations listed here all try to accomplish the same thing: they make it difficult for an illegal entrant to gain access. With the non-professional vandal particularly in mind, any of the difficulties you put in his path should be quite obvious. This type of miscreant usually picks out the easiest looking place, without carefully thinking about his choice in advance, as would the professional, in terms of what he stands to gain. This means that you are wrong in feeling safe just because you think there isn't enough in your shop to make breaking in worth while. The best protection against the random drunk or the delinquent seeking thrills is to make it clear to him that some effort will be required. He will quickly turn to an easier looking prospect.

Cash, merchandise, equipment, and property are not the only things that must be protected. A conscientious shop owner who may take measures to safeguard these may nevertheless overlook business records. The real value of these is appreciated fully only by someone who has lost them by theft, vandalism, or fire. Therefore, storing them in a burglar-proof location is not enough: the place where they are kept should also be fireproof.

On the subject of fire, losses from this cause can be as damaging, or more so, than those incurred through the misfortunes already mentioned. No program of protection is complete that omits positive steps to guard against conflagration while the shop is in use and when it is unoccupied as well. Here are some suggestions: Empty every waste basket before closing up every night, disposing of the contents and all other trash someplace outside the building. Disconnect all equipment, appliances, tools, etc., except for necessary lighting. Don't overload electrical circuits ever. Check wiring and fixtures on a regular basis. Make sure that wiring is adequate. Guard against mice, rats, and other vermin. When they occur, begin extermination measures immediately. In their prowling and gnawing, these creatures can create fire hazards.

Finally, if a loss should occur even after preventive measures have been taken, what you do afterward may have bearing on future safety. If the loss has brought to light an overlooked weakness in your set of protective measures, act to correct it. If a burglar or vandal is apprehended, don't get soft-hearted. Be tough on prosecution. Cooperate with authorities. It will pay off in the long run, as it can prevent a future repetition. —30—

Shopping for Hi-Fi Amplifier

(*Continued from page* 41)

spend more of their time "outgoing" than "incoming." Program material containing wind instruments, particularly of the trumpet or horn group, can often produce a kind of distortion peculiar to amplification of this instrument.

This will usually sound wavery rather like the last kind of distortion, except that the wavery effect is at a lower frequency: rather as if the player is dribbling into his instrument. This happens because the asymmetrical waveforms upset the balance of the amplifier and it starts into a distortion of its own.

None of the test methods currently employed use an asymmetrical waveform to test the amplifier. Consequently, program material that produces an asymmetrical waveform will often cause effects not found during normal tests.

It should be noted that some of these effects are not solely due to the way the amplifier behaves, although usually the amplifier is a contributing component. But the same amplifier may behave quite well when connected to one loudspeaker and yet behave poorly on one of these tests when using another loudspeaker. This is not necessarily because the second loudspeaker does not handle the program as well. It can be because the way the loudspeaker impedance loads the amplifier upsets its balance. Consequently, its performance is not so good when using the second loudspeaker. Connecting the second loudspeaker to another amplifier may result in quite satisfactory performance.

This fact has resulted in some quite confusing conclusions. Naturally one supposes when an amplifier and loudspeaker perform well together that both must be satisfactory. If changing the loudspeaker causes the performance to deteriorate, then presumably the second loudspeaker is defective or inferior. Surprisingly, using a different amplifier may reverse the conclusion with regard to the two loudspeakers in question.

The "Final" Test

This final fact is an argument for testing a hi-fi amplifier with the particular loudspeaker setup you intend to use, either having the amplifier delivered for approval to test in your own living room with your own loudspeaker or else having it tested with an identical loudspeaker system in the showroom.

So when shopping for an amplifier don't assume that one amplifier is as good as another provided it gives enough power with low enough distortion and the proper frequency response. Listen to it with your particular audio setup. This is the only way to be sure that the over-all system will give the fidelity you expect of it. —30—

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1H5GT
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1L4
1L6
1N5GT
1Q5GT
1R5
1S5
1T4
1T5GT
1U4
1U5
1V2
1X2
2A3
2A7
2AF4
3AL5
3AU6
3AV6
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3BE6
3BN6
3BY6
3BZ6
3CB6
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3CS6
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3Q4
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3S4
3V4
4BC8
4BQ7A
4BZ7
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5AN8
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5AW4
5AX4GT
5AZ4
5BK7
5BR8
5BQ7
5CG8
5J6
5T8
5U4G
5U4GA
5U4GB
5U8
5V4G
5V6GT
5X8
5Y3GT
5Y4G
6A7
6A8
6AB4
6AB7
6AC7
6AF4
6AG5
6AG7
6AH4GT
6AH6
6AK5
6AL5
6AL7
6AM8
6AN8
6AQ5
6AQ6
6AQ7GT
6AR5
6AS5
6AS7G
6AT6
6AT8
6AU4GT
6AU5GT
6AU6
6AU8
6AV5GT
6AV6
6AW8
6AX4GT
6AX5GT
6B4G
6B8
6BA6
6BA7
6BC5
6BC7
6BC8
6BD6
6BE6
6BF5
6BF6
6BG6G
6BH6
6BJ6
6BK5
6BK7
6BL7GT
6BN6
6BQ6GT
6BQ7
6BS8
6BX7GT
6BY5G
6BY6
6BZ6
6BZ7
6C4
6C5
6C6
6CB5
6CB6
6CD6G
6CF6
6CG7
6CL6
6CM6
6CM7
6CN7
6CS6
6CU5
6CU6
6D6
6DE6
6DQ6
6DT6
6E5
6F6
6F8
6H6
6J4
6J5
6J6
6J7
6K6GT
6K7
6K8
6L6
6L7
6N7
6Q7
6S4
6S8GT
6SA7
6SB7Y
6SC7
6SF5
6SF7
6SG7
6SH7
6SJ7
6SK7
6SL7GT
6SN7GT
6SQ7
6SR7
6SS7
6T4
6T8
6U4GT
6U5
6U8
6V3
6V6
6W4GT
6W6GT
6X4
6X5
6X8
6Y6G
7A4/XXL
7A5
7A6
7A7
7A8
7B4
7B5
7B6
7B7
7B8
7C4
7C5
7C6
7C7
7E5
7E6
7E7
7F7
7F8
7G7/1232
7H7
7J7
7N7
7Q7
7X7/XXFM
7Y4
7Z4
12A8
12AB5
12AQ5
12AT6
12AT7
12AU6
12AU7
12AV5
12AV6
12AV7
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12DQ6
12F5
12J5
12K7
12L6
12Q7
12SA7
12SG7
12SJ7
12SK7
12SL7GT
12SN7GT
12SQ7
12SR7
12V6GT
12W6GT
12X4
12Z3
14A7/12B7
14B6
14Q7
19
19AU4GT
19BG6G
19J6
19T8
24A
25AV5
25AX4
25BQ6
25DN6
25L6GT
25W4GT
25Z5
25Z6
26
35A5
35B5
35C5
35L6GT
35W4
35Y4
35Z4GT
35Z5GT
36
37
39/44
42
43
45
50A5
50B5
50C5
50C6
50L6GT
50X6
50Y6
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57
58
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77
78
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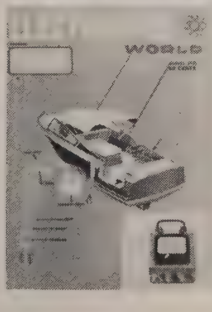

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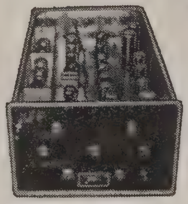

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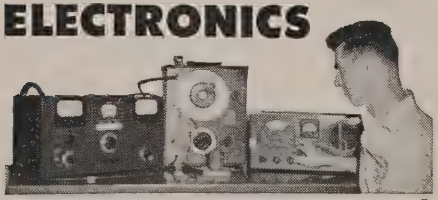

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Stereo Amplifier Controls

(Continued from page 57

bined signals are called a phantom channel, after telephone practice. Fig. 16 shows the basic method employed by some stereo control amplifiers for deriving the phantom channel. Two resistors in series are connected between the left and right channel output jacks and the junction of these resistors is connected to the phantom output jack. This method results in a fixed ratio between the left and right signals. But if the balance control is set to favor one channel (perhaps to compensate for lower efficiency of the speaker fed by this channel), then the phantom channel will not contain equal parts of the left and right signals. Therefore, as shown in Fig. 17, provision may be made for varying the portions of each signal. Instead of having two fixed resistors to link the phantom channel with the other two channels, a potentiometer can be employed, with each leg going to one of the original channels and the arm connected to the phantom channel output jack.

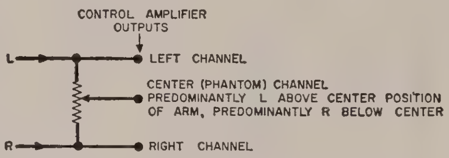

CONTROL AMPLIFIER OUTPUTS
L
LEFT CHANNEL
CENTER (PHANTOM) CHANNEL
PREDOMINANTLY L ABOVE CENTER POSITION OF ARM, PREDOMINANTLY R BELOW CENTER
R
RIGHT CHANNEL

Fig. 17. Phantom channel with mixing.

Stereo Power Amplifiers

Stereo power amplifiers frequently provide several basic channel switching facilities. Fig. 18 is representative. A channel reverse switch serves the same purpose as the reverse stereo switch in Fig. 9. A monophonic-stereo switch serves the same function as the quasi-stereo switch in Fig. 12, permitting the left (or right) signal to be fed to both channels.

Sometimes the stereo power amplifier has a switch that parallels both output stages, as shown in Fig. 19, so that the power which can be fed to a monophonic speaker system is increased.

Fig. 18. Circuit arrangement at the right shows how switching of the channels may be accomplished in a typical stereophonic amplifier. Refer to text.

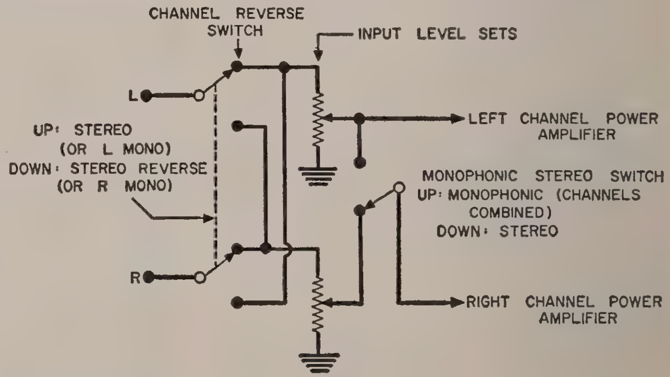
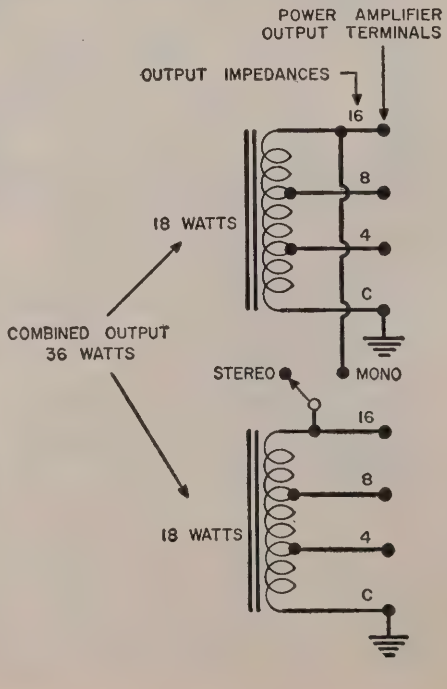

CHANNEL REVERSE SWITCH
INPUT LEVEL SETS
L
R
UP: STEREO (OR L MONO)
DOWN: STEREO REVERSE (OR R MONO)
LEFT CHANNEL POWER AMPLIFIER
MONOPHONIC STEREO SWITCH
UP: MONOPHONIC (CHANNELS COMBINED)
DOWN: STEREO
RIGHT CHANNEL POWER AMPLIFIER

Fig. 19. Switch for feeding both outputs of stereo amplifier to a monophonic speaker.



Stereo Adapters

The foregoing discussion has covered three types of stereo amplifiers: (1) control amplifiers; (2) integrated control and power amplifiers; and (3) power amplifiers. A fourth category consists of units designed to adapt two monophonic control amplifiers to stereo use. Several such adapters on the market contain a master gain control, channel switching facilities, and, on occasion, a blend control or balance control, or both.

Some adapters are intended for insertion between the control amplifier and the power amplifier. Others, to permit reduction of signal level before amplification stages of the control amplifier and thereby minimize distortion, are intended for use with control amplifiers that contain a tape-monitor switch. Such a switch breaks the signal path from selector switch to gain control, permitting the adapter to be inserted in this path. Specifically, the signal goes from the tape output jack of the control amplifier into the adapter, from the adapter to the tape input jack of the control amplifier, and thence to the gain control of the latter. Since the adapter pre-empts the tape output and tape input facilities of the control amplifier, it becomes necessary for the adapter to replace these facilities. —30—

Citizens Radio Transmitter

(*Continued from page* 51)

a 96" whip will be definitely superior.

Adjustment of the transmitter, after it has been installed in its case and the antenna has been connected, follows the same pattern as when preliminary tests were made in conjunction with a dummy antenna. The final amplifier input must not exceed 5 watts. Consequently, with a supply voltage of 250, plate current may not exceed 20 ma. Since the test meter is connected in the cathode of V_{1B}, it indicates the total screen and plate current drawn by the final amplifier. By subtracting 4 ma. (the approximate screen current) from the reading shown on the meter, you will obtain a value which is sufficiently close to the actual plate current to be satisfactory for power input computations. In other words, a 24 ma. reading on the test meter is equivalent to a plate current of 20 ma. In order to keep the tubes from overheating and to prevent damage to the crystal, do not attempt to operate the transmitter from a power supply that furnishes much more than 250 volts under load.

Although the 5-watt power limit imposed on class D Citizens Radio gear may seem quite low to those who are accustomed to reading about 50-kilowatt broadcast stations, excellent results can definitely be provided by the small transmitter which has been described. When used with a sensitive receiver and a properly installed antenna, it will have a range of at least 5 miles over practically any form of terrain. In open country, signals can be expected to extend up to 10 miles or more. Over water, weak but usable signals should be heard at least 15 miles away. These results, of course, will only be achieved while operating on a clear channel. Since the 27 mc. Citizens Band is shared with the Industrial, Scientific, and Medical Service, the raspy buzz of nearby diathermy machines may cause interference from time to time. Transmissions from other Citizens Stations will also affect weak signal reception. Now and then, when propagation conditions are good, stations from clear across the continent may even be picked up.

A complete set of rules concerning the Citizens Radio Service is available from the Government Printing Office, Washington 25, D. C. When ordering, enclose 10¢ in coin and request Catalogue No. CC 1.7:19/4, *Federal Communications Commission Rules and Regulations, Part 19*. You must certify that you have these rules in your possession when applying for a Citizens License. A copy of FCC Form 505, "Application for Citizens Radio License" may be obtained free of charge by writing to the FCC, Washington 25, D. C. *DO NOT* attempt to operate a unit similar to the one described in this article until you have a valid license in your possession! —30—

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TN-2, 80-300 Mc........................ 15.00
TN-3, 300-1000 Mc........................ 19.95

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Frequency 300-1000 MC in one band. Individually calibrated direct reading dials. Frequency Accuracy ± 0.5%. Output voltage continuously variable from 0.1-100,000 microvolts. Output impedance 50 ohms. Modulation 0.30%. Choice of 400, 1000, 250 cycles. Pulse frequency 60-100 kc. in three ranges: 60-1,000, 600-10,000; and 6,000-100,000 pulses per second. Power supply 117 V., 50/60 cycles. Dim.: 13 x 26 x 12⅛". Approx. ship wt. 160 lbs. Excellent. Checked out.......... **$195.00**

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- The advertised tubes are not necessarily new, but may be electrically perfect factory seconds or used tubes—each is clearly so marked.

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0Z4
1A7GT
1B3GT
1H4G
1H5GT
1L4
1L6
1N5GT
1Q5GT
1R5
1S5
1T4
1U4
1U5
1V2
1X2
2A3
2AF4
3BC5
3BN6
3BZ6
3CB6
3CF6
3CS6
3LF4
3Q4
3S4
3V4
4BQ7A
4BZ7
5AS8
5AT8
5AV8
5AW4
5BK7
5J6
5T8
5U4G
5U8
5V4G
5V6GT
5X8
5Y3GT
5Y4G
6A7
6A8
6AB4
6AC7
6AF4
6AG5
6AG7
6AH4GT
6AH6
6AK5
6AL5
6AL7
6AM8
6AN8
6AQ5
6AQ6
6AQ7GT
6AR5
6AS5
6AT6
6AT8
6AU4GT
6AU5GT
6AU6
6AU8
6AV5GT
6AV6
6AW8
6AX4GT
6AX5GT
6B8
6BA6
6BC5
6BC8
6BD6
6BE6
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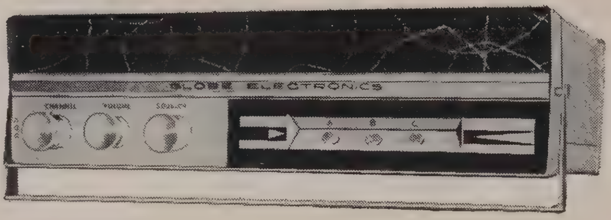

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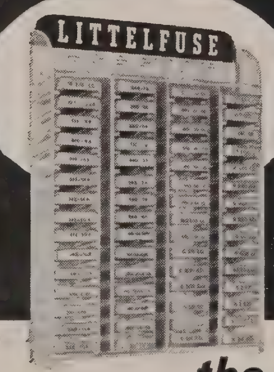

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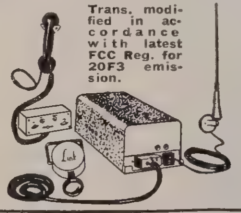

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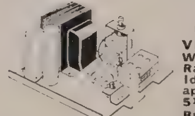

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Electronics in Outer Space

(Continued from page 38)

electrically insulated from the housing shell of the missile.

For some space vehicles—like the "Vanguard" satellites—the payload is essentially a cylinder (Fig. 1) containing a number of closely packed decks or compartments (Fig. 2).

In larger space probes with considerably more space and weight available, the payload is more elaborate—as for the "Pioneer I" (Fig. 5).

All of these are new and highly specialized applications of electronics, because of the peculiar mechanical and electrical requirements of operation in outer space. Qualities which are normally desirable in electronic equipment now become essential. The cost of placing a vehicle in space, long telemetering life, and the impossibility of maintenance place a tremendous emphasis on the reliability of all electronic equipment. Reductions in size, weight, and volume are mandatory and operating power requirements must be held to an absolute minimum to conserve available power supplies. These are but a few of the many specialized requirements of the electronics payloads for satellites and space probes. Some indication of how these problems have been surmounted is reflected in the intricate sensory units, data converters, tape recorders, radio transmitters, and other equipment contained in the electronics payload.

Other than anticipated power depletions, there has never been a failure of electronic circuitry. Most of the components of the electronics payload covered in these articles have been tested and proven in flight; others will be tested aboard future satellites and space probes.

Radio: Tracking Transmitters

Space vehicles are invariably equipped with at least *two* radio transmitters: a beacon or tracking transmitter and a data or telemetering transmitter.

All U. S. satellites and space probes are equipped with a beacon or tracking transmitter.

This transmitter broadcasts a continuous audio signal on 108.00 mc. which enables ground receiving stations to track the passage of the vehicle in space. Although it varies slightly in design and construction, all U. S. beacon transmitters are essentially the same.

The considerable amount and variety of data collected by sensory units aboard most space vehicles require the beacon transmitter to also handle part of the scientific data load that is broadcast to the ground. Thus, to supplement the data transmitted, the beacon or tracking transmitter may *also* broadcast telemetered signals on its nominal frequency.

A typical beacon transmitter (Fig. 7) broadcasts both standard tracking signals and coded temperature or other data on 108.00 mc. The two oscillator stages of the transmitter utilize the same battery, which is convenient and possible because of the inherently low drain on the power supply of the r.f. oscillator stage. The r.f. stage is a crystal-controlled transistor oscillator, using an AT-cut crystal operating on its fifth overtone. With this series-resonant quartz crystal in the feedback circuit, it is essentially a Hartley oscillator. An inductance across the crystal raises the non-resonant impedance of the stage. It has an output of 10 milliwatts, which is typical of most tracking transmitters.

The telemetering stage (Fig. 7) is a simple transformer-coupled oscillator. Frequency of operation is determined by the tuned circuit composed of the primary of the transformer, a temperature-sensitive resistance, and two capacitors. Voltage developed in the secondary winding of the transformer is used to modulate the frequency of the r.f. oscillator stage in accordance with small changes in temperature, or other data.

To provide *another* data signal *via* the tracking transmitter, such a signal—particularly if brief and aperiodic—can be used to interrupt the r.f. oscillator stage. By any of several conventional methods, the tracking transmitter can convey several data signals on its nominal frequency of 108.00 mc.

Tracking signals broadcast by a space vehicle are important for other reasons. Reception of these signals on the ground permits accurate plotting of the orbit or path of the space vehicle. From changes in orbit—due to drag of the residual atmosphere and the attraction of the earth's equatorial bulge—the density of the upper atmosphere can be determined and deductions about the shape and size of the earth can be made scientifically.

Tracking by electronics is much more accurate than optical or visual tracking. Thus, the tracking or beacon signals are of considerable significance in the collection of scientific data. And a tracking transmitter adds negligible weight and volume to the space vehicle (Fig. 6).

Part 2 will go into detail on more of the specific electronic equipment carried by our satellites and space probes.

(*To be continued*)

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By MILTON WHITE

COUPLE a fused line-connector plug to a garage receptacle through a short length of line cord to form the handy fuse cut-out shown in the photograph below.

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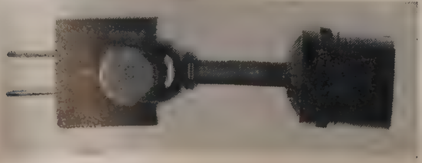

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3AU6	.51	6AG5	.65	6C4	.43	6X8	.77	12SK7GT	.74
3AV6	.41	6AH6	.99	6CB6	.54	6Y6G	.65	12SN7GT	.64
3BZ6	.55	6AK5	.95	6CD6	1.42	8AU8	.83	12V6GT	.53
3BY6	.55	6AL5	.47	6CF6	.64	8AW8	.93	12W6	.69
3CB6	.54	6AM8	.78	6CG7	.60	11CY7	.75	17AX4	.67
3CF6	.60	6AN8	.85	6CG8	.77	12A4	.60	17BQ6	1.09
3DT6	.50	6AQ5	.50	6CM7	.66	12AD6	.57	19AU4	.83
3V4	.58	6AT6	.43	6CN7	.65	12AF6	.49	19BG6	1.39
4BN6	.75	6AT8	.79	6CS6	.57	12AQ5	.52	19T8	.80
4BQ7	.96	6AU4GT	.82	6CU6	1.08	12AT6	.43	25BQ6GT	1.11
4DT6	.55	6AU6	.50	6CY7	.71	12AT7	.76	25C5	.53
4BZ7	.96	6AU8	.87	6DE6	.58	12AU6	.50	25CD6	1.44
4CB6	.59	6AV6	.40	6DG6GT	.59	12AU7	.60	25CU6	1.11
5AM8	.79	6BA6	.49	6DQ6	1.10	12AV6	.41	25L6	.57
5AN8	.86	6BC5	.54	6DT6	.53	12AV7	.75	35C5	.51
5AQ5	.52	6BD6	.51	6J5GT	.51	12AX7	.63	35Z5GT	.60
5AT8	.80	6BE6	.55	6J6	.67	12AZ7	.86	50B5	.60
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5BQ7	.97	6BG6G	1.66	6L6	.84	12BD6	.50	50L6GT	.61
5CG8	.76	6BH8	.87	6S4	.48	12BE6	.53		
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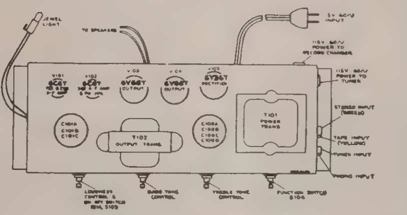

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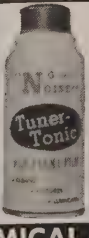

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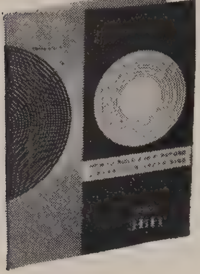

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"TELEVISION RECEIVER SERVICING" by Milton S. Kiver. Published by *D. Van Nostrand Co., Inc.,* Princeton, N. J. 308 pages. Price $5.95. Soft cover. Fourth Edition.

Here is a new and up-to-date edition of a deservedly popular and thoroughly practical handbook for the television service technician.

Since the Third Edition appeared in 1953, many changes and improvements have been made in receiver circuitry. Reflecting this trend, this volume contains 150 new illustrations plus a new chapter on the operation and servicing of color television sets.

As was the case with the earlier volumes, the author has stressed the practical and minimized the purely theoretical. There are chapters on the antenna system, receiver installation, test equipment, r.f. and video detector stages, cathode-ray picture tubes, test patterns, deflection systems, FM, receiver alignment, and u.h.f. television.

Two valuable addenda, an interference rundown and a "TV Defect Directory," complete the text. The author has used photographs, line drawings, graphs, schematics, and TV scope patterns lavishly in amplifying his text material.

The practicing technician will find much information of value in this handbook—presented in a style which is both clear and complete.

* * *

"BUILDING THE AMATEUR RADIO STATION" by Julius Berens, W2PIK. Published by *John F. Rider Publisher, Inc.,* New York. 124 pages. Price $2.95. Soft cover.

This slim volume is a sequel to the same author's practical handbook, "Getting Started in Amateur Radio." Assuming that the reader of the first volume has received his ham ticket, this book continues the "course" by helping him to build or buy the appropriate equipment for his ham shack.

The author heartily endorses the "build-it-yourself" school of hams since he feels that amateur operation should be a learning and growing process rather than merely one of making contacts. For this reason, four out of the six chapters are devoted to the "home-brewed" station with a fifth chapter covering commercially available ham gear, and the final chapter devoted to operating the station. He even covers the tools, hardware, and other miscellaneous items needed by the constructor and operator of the ham station.

Schematics and parts lists are included for all of the gear needed in both a Novice class station and that operated by the holder of a General class ticket. Those who have recently joined the ham fraternity or have upped their grade will find this manual especially helpful in getting on the air.

* * *

"THE RADIO HANDBOOK" edited by William I. Orr. Published by *Editors and Engineers Ltd.,* Summerland, Calif. 798 pages. Price $7.50. 15th Edition.

One of the ham's invaluable reference books, the latest edition of this volume is considerably broader in scope than the previous edition, which appeared about 3 years ago. The present volume is slanted not only toward the advanced amateur, but also to practical radiomen, technicians, and engineers who are in communications. For example, new chapters are included on electronic computers, feedback amplifiers, high-fidelity techniques, and much additional information has been included on semiconductors and special vacuum tubes.

Other chapters have been brought up-to-date and some aspects of industrial and military electronics fields have been touched on. The construction material has been re-edited and the equipment described is of modern design with minimum TVI and spurious oscillations.

In spite of all the new material that has been added, the hard core of useful basic information has not been diluted and this volume still contains a wealth of practical information.

* * *

"TRANSISTORS" by Angelo C. Gillie. Published by *Prentice-Hall, Inc.,* New York. 254 pages. Price $7.95.

Here is an excellent basic text written at an intermediate level and without recourse to advanced mathematical procedures. Anyone with a working knowledge of Ohm's Law, a.c. theory, and elementary algebra should have no difficulty with this straightforward presentation.

The text material has been divided into eleven chapters dealing with linear and nonlinear conductors, nonlinear resistive control devices, characteristics of germanium and silicon, semiconductor diode action, the photo transistor and its applications, the junction transistor, junction transistor applications, the point-contact transistor and its applications, and other semiconductor devices.

Since the author is Phase Coordinator of Electronic Fundamentals and Circuit Analysis at Ward School of Electronics, it is safe to assume that this volume was written for classroom use. Since problems are appended to each chapter (with answers given at the back of the book), this volume could also be used by the "do-it-yourself" seeker after knowledge.

The discussion is clear, concise, and admirably presented. The progression is logical and straightforward. For those with some practical or theoretical knowledge of transistor electronics who want to know more about this vital subject but are not equipped to tackle the usual engineering text this book should provide the perfect answer to the question "What book on transistors should I buy?"

* * *

"REPLACEMENT GUIDE FOR TV AND AUTO RADIO CONTROLS" compiled by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 80 pages. Price $1.00. Soft cover. Second Edition.

This compact and concise listing of replacements includes controls manufactured by *Centralab, Clarostat, International Resistance,* and *Mallory.* This compilation covers over 22,000 TV models marketed under some 126 brand or proprietary names and 890 auto radio models from 42 companies.

In each instance the industry number is given for the model listed and then, in a special table, the equivalents from one or all of the control manufacturers are given.

A special section lists *IRC* "Concentrikit" and *Mallory* "Sta-Loc" equivalents.

Those whose livelihood depends on efficient and speedy restoration of their customers' TV and auto radio sets will find this Guide especially helpful in determining suitable replacements when exact duplicate parts aren't readily available. —30—

CALENDAR of EVENTS

AUGUST 18-21

Western Electronic Show and Convention. Cow Palace, San Francisco. Sponsored by WESCON and Los Angeles and San Francisco sections of the Institute of Radio Engineers. Technical sessions and field trips. Contact Albert J. Morris, convention director, 1435 S. La Cienega Blvd., ℅ WESCON Headquarters, Los Angeles 35, for program details.

SEPTEMBER 1-3

14th National ACM Conference. Massachusetts Institute of Technology, Cambridge, Mass. Convention papers on numerical analysis, data processing, automatic programming, digital and analogue devices, etc. Contact Dr. Frank M. Verzuh, Computation Center, MIT, Cambridge, Mass., chairman of Local Arrangement Committee, for further details.

SEPTEMBER 18-20

8th Annual High Fidelity Show and Music Festival, Palmer House, Chicago. Sponsored by International Sight and Sound Exposition, Inc. For full details, contact S. I. Neiman at One N. La Salle St., Chicago 2. Show to be open to public.

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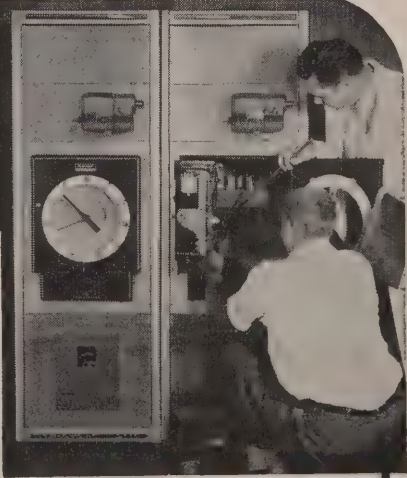

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Service Industry News

REPORTING to the Electronic Industries Association at its annual convention in Chicago, Service Committee Chairman Kenneth H. Brown, of the *Westinghouse Electric Corp.,* indicated the growing interest of members in helping the service industry to resolve some of its problems.

The report submitted by Chairman Brown said, "The Committee believes that it now has an opportunity to make an additional contribution by working to increase the prestige and business ability of the service technician. Our planning of the past year has, therefore, been directed to such a program.

"Independent service has more than played its part in the phenomenal growth of the industry but, unfortunately, full credit to the servicing industry has been marred by a few adverse commentaries about some service technicians and their practices. We believe that a comparatively few are responsible for such reports and that this minority should not lessen the complete credit due the independent service industry.

"While many segments of our industry have taken advantage of the opportunities presented by rapid growth, some have failed to fully realize the business changes that must be made and the industry-wide responsibilities that must be accepted under conditions of growth and maturity. We believe that the solution of new and unexpected problems can best be achieved by mutual effort of the independent service industry, individual manufacturers, and EIA."

EIA Meets with ESFETA

Prior to the annual convention, the Industry Relations subcommittee, under Steven R. Mihalic, of *General Electric Co.,* met with officers of the Empire State Federation of Electronic Technicians Associations, Inc., to discuss service problems.

ESFETA President Robert Larsen identified four major problems which he said could be best solved through an industry-wide approach. These are: (1) jobber sales to retail customers; (2) education of customers in realities of TV service, and of technicians in non-technical aspects of conducting a service business; (3) unrealistic tube discount structure, and (4) non-uniform and unclear warranties.

Subcommittee Chairman Mihalic, Manager of Product Service, TV Receiver Department of *G-E,* explained EIA's objectives and pointed out that, as an association of manufacturers, it could not deal directly with some phases of the industry's problems. But EIA's embryo non-technical education plan was described as a means of improving the service dealers' ability to cope with the problems of customer relations, business management, advertising and promotion, and relations with factory, distributor, and dealer.

The program under development may include texts, films, and such written material as is presently available from member firms. The program is to be prepared by professional people under EIA sponsorship.

TESA-Miami Jobber Program

The Radio & Television Technicians Guild of Florida, Inc., which is now in the process of changing its name from RTTG to TESA-Miami, has made excellent progress in its program to put service dealer-jobber relations on a more stable foundation. Shan Desjardins, editor of "TESA-Miami News," recently said of the program:

"The parts distributors who have accepted and signed the policy statement which appears on the opposite page, are doing so in good faith. Time will prove the sincerity of their agreement. The service industry should also show good faith by accepting their pledge and good intention to fulfill their obligation.

"A beginning has been made in our struggle to correct certain abuses in distributor wholesale practices. There are still many problems to be overcome. Committees are yet to be appointed and men selected from both sides to iron out differences of opinion, establish rules of conduct, qualify those who are entitled to purchase at wholesale, enlist the support of other industries in correcting abuses, and setting up a control and check system which would be acceptable to both sides."

The "Distributors Statement of Policy," which TESA-Miami recommended to parts distributors as the basis for better inter-industry relations, includes the following seven points:

1. To maintain an adequate warehouse stock to insure prompt service to our service-dealer customers. 2. To operate and maintain a separate sales force, counter and order department, and delivery facility designed to meet the needs of our service-dealer customers. 3. To actively solicit business from *bona fide* service dealers only. To restrict sales to qualified, authorized purchasers only. 4. To maintain an announced, uniform, pricing structure for all *bona fide* service dealer customers which, while competitive, gives

advantages to none and is fair to all. 5. To operate a firm and fair credit policy, uniformly administered to all service-dealer customers in line with sound business practices. 6. To engage in special service-dealer promotions to assist our customers in improving and strengthening their businesses. 7. To support continuously the efforts of those manufacturers who, by their actions, have shown their interest in the future of the Independent Electronic Service Industry.

NATESA Nashville Meeting

Delegates returning from the NATESA annual spring convention, held this year in Nashville, Tenn., acclaimed it the biggest and best ever held by that organization. It was reported that more than 200 dealers and technicians from all sections of the country attended the two-day affair.

Frank J. Moch, executive director for NATESA, reported that 21 new affiliates joined the national association since last year's convention. He also stated there is a strong upsurge of interest in forming service associations in new areas.

TEA-Houston Elects

The members of the Texas Electronics Association of Houston, P. O. Box 6293, Houston 6, Texas, picked the following slate of officers at their annual election: Floyd Young, president; T. B. Drisdale, vice-president; R. C. Dawson, secretary; Rex Phelps, treasurer. Directors named include: Larry Wawrosky, G. A. Galbreath, B. A. Thompson, Norris Browne, Lawrence Domingo, Eugene Heller, D. C. Larson, James L. Williams, and Michael Chaplinski.

Laforet Heads TSA-Michigan

Patrick L. Laforet of the *American Antenna & Receiver Co.*, Detroit, was elected president of TSA of Michigan at the recent annual election. He succeeds Karl Heinzman of *H & M Electric*.

Other officers selected by the membership include Michael Graham, *Graco TV & Radio*, secretary; Isa Katuah, *New Center Electronics*, treasurer; Lawrence Nelson, *Globe TV*, central vice-president; Calvin Longton, *Longton TV Bros.*, south vice-president; Charles March, *Vutronic TV*, NW vice-president; Lou Hudson, *Hudson TV*, east vice-president; and Tom Goode, *Televox TV*, west vice-president.

Dallas Wage Survey

A survey made by the United States Department of Labor, which covered 21 service shops employing 50 technicians in Dallas, Texas, indicated that TV and radio repairmen in that area earned an average of $83.50 weekly during the month of March. "Combination" service technicians, those who did both bench and outside work, were the highest paid. These technicians received an average of $92.00 per week. Bench men who worked only in the

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☐ Submini size. 100's of projects: audio, interstage, etc. Reg. $10. 88¢

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35 TWO-WATTERS
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☐ Powered by penlite battery. 6 oz. Hobbyists, note! Reg. $8. 88¢

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☐ Similar to famed B2M. 1" long. Reg. $2.50. 88¢

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40 TUBE SOCKETS
☐ 4 to 9-pin; ceramic, mica, shield-based incl. 2 lbs. Reg. $10. 88¢

2 TRANSISTOR IF'S
☐ Double-tuned. Only ½" square. 456 kcs. 88¢

70 TBLR COND'NS'RS
☐ Paper, molded, oil, porc.; to .5mf to 1000V. 2 lbs. Reg. $14. 88¢

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☐ Strips, cuts #16 thru #22 hookup wire. Wt. 1 lb. 88¢

10 ELECTROLYTICS
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60 RADIO-TV KNOBS
☐ Asstd. colors, insulation. Some worth $1 ea. 2 lbs. Reg. $17. 88¢

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☐ For home & auto. Box & open; 15/64 thru 7/16". 16 sizes. Reg. $2.50. 88¢

70 ONE-WATTERS
☐ Asstd. value carbon resistors. 5%, too! 88¢

2 NPN TRANSISTORS
☐ Used in Pop. make radios. 88¢

35 POWER RESISTORS
☐ WW. 5 to 50W, to 10,000 ohms. Vitreous, too! 3 lbs. Reg. $15. 88¢

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☐ Mechanisms; precision geared. 2 lbs. Reg. $30. 88¢

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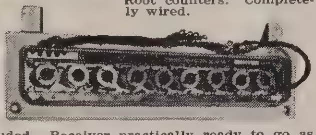

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300 VDC. POWER SUPPLY KIT
Ideal for 1215 Mc. Transmitter-Receiver. Complete with diagram. Includes power transformer, choke, jewel light, switch, fuse holder, 5Y3 tube w/socket, etc. Brand New....... **$12.95**

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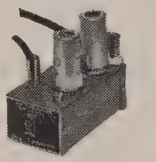

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shop earned an average of $81.50, and outside men received $75.50 weekly on an average. Helpers averaged $41.50 per week.

The survey did not include factory-branch or retail-store technicians. Neither did it cover about two-thirds of the 250 independently owned repair shops in Dallas County because they employed no full-time workers.

TEAM Election

The Electronic Association of Missouri, 4134 Easton Ave., St. Louis 13, Mo., elected the following officers to lead the organization for the coming year: W. C. Pecht, *Goodfellow Electric Service,* president; Stanley Siegel, vice-president; Arthur A. Mayer, secretary-treasurer; Robert Lucas, recording secretary; Ken Schmidt, sergeant-at-arms. Directors named include F. B. Floyd, Ed Laurence, and Herman Wolfe.

St. Louis Service Event

In St. Louis, Mo., manufacturers, distributors, representatives, and the two local service associations pooled their efforts to make an outstanding success of a three-day service event recently held there. The program included displays of parts and equipment, demonstrations, and educational seminars under the guidance of nine nationally known speakers. It was developed and promoted by committees representing all elements of the industry, working together in an organization known as "The Electronics Club." It was reported that attendance during the three-day series topped 8000.

Membership Benefits

The association's hospital, surgical, and weekly-income benefit plan covered in a recent issue of the "TSA (Delaware Valley) News" is an excellent illustration of just one important advantage service dealers have gained through banding together. While many other service groups have made arrangements for similar plans for their members, a review of the elements in this program points up the value of such collective insurance plans to small-business operators who cannot, in the normal run of things, obtain such benefits in other ways:

There are no age limits, no required physical examinations, and pre-existing conditions are not excluded from coverage. Benefits begin at once with no waiting period, for either employers or employees. This includes waiver of waiting periods before maternity benefits can be used, but there is a 9-month waiting period before other benefits apply to dependents. Shop owners who are TSA members find this arrangement particularly valuable, since proprietors or partners cannot be covered by regular Workmen's Compensation Insurance in Pennsylvania. Additional information on this particular plan may be obtained by writing Ray Fink, Editor, "TSA News," 7819 Rugby St., Philadelphia 50, Penna. —30—

One-Tube FM Front End

(Continued from page 54)

If drift has caused the i.f. voltage to change, this change is coupled back to the oscillator and, in turn, corrects the oscillator. Remember that, in more conventional systems for automatic frequency control, a corrective voltage that depends on the extent of drift is also used to re-adjust oscillator frequency.

So much for the operation of the circuit. Concerning the reasons for choosing such a design, we need not go into these in great detail. It is worth noting that the use of triodes instead of pentodes or a pentagrid converter substantially reduces the problem of noise generated by the circuit itself. The more electrodes that become involved in the tubes used, the greater random electron activity is generated.

The autodyne converter is a highly efficient circuit for other reasons, too. Take the case of the pentagrid converter, in comparison. A certain amount of electron current originates at the cathode. A great deal of this current never reaches the plate, being taken up by others of the several intervening electrodes. Thus the amplified i.f. output at the plate is kept considerably below what one might expect. Although a triode would not appear to have as much theoretical gain as a tube with more elements used in its place, most of the electron current originating at the triode cathode is effective at the plate, resulting in high efficiency. This means appreciable i.f. output.

The greatest value in knowing the "ins" and "outs" of this type of front end, to the practical technician, is the bearing such information has on service and alignment. To begin with, we are here dealing with a very compact design in which there is a great deal of close coupling between different portions of the circuit and in which many components are actually operative in more than one role. Thus we know that any adjustment or component change is likely to be more sensitive than would be the case in a less integrated design. All capacitors, especially those serving a dual purpose, are critical. Relatively slight changes in them might have noticeable effects on circuit action. If they are to be replaced, exact values should be respected as closely as possible. This would pertain to all other characteristics aside from their capacitance, particularly temperature coefficients. Capacitor type, size, shape, physical location and dress should be duplicated as closely as possible.

Alignment components, since they may affect more than one circuit, must be adjusted with care and usually in a specific sequence. The 2nd detector and i.f. strip of the tuner in which an autodyne front end is found should always be aligned first. This is good procedure with any FM tuner or receiver, but is particularly important here, even if trouble is believed to be directly in the r.f.-converter portion.

If there is any reason to suspect that the front end is oscillating, or if the twin triode it employs has been replaced, adjustment of the neutralizing trimmer (C_7 in Fig. 1) should be checked. Of course, if the r.f. amplifier is of the cathode-fed grounded-grid type, no problem exists here. One should also remember that any change in plate voltage to this stage, as when a resistor in the "B+" line has been overheated, may also produce improper operation. Therefore, especially after a short within a tube has occurred, this possibility should be looked into.

To adjust the neutralizing trimmer—after all other adjustments have been made—filament voltage should be removed from the twin triode altogether, usually by removing one filament lead. The signal generator is then set up for output at about 100 mc. with audio modulation. If the stage is not properly neutralized, the modulation should be audible. C_7 is then adjusted for a null—that is, to eliminate audio output. In some cases, it may be necessary to disconnect the load capacitor across the output of the ratio detector to enable the audio to be heard. It is also possible to use a v.t.v.m. at the grid of the limiter, where such a stage is used, to obtain a visual indication of the null.

There is another expedient for making this adjustment, but it is not the preferred method if adequate equipment is on hand. The trimmer may be rotated until the receiver breaks into oscillation. Then the adjustment is rotated back about a quarter of a turn from this point. This will allow a small margin for component aging, line voltage variation, and other such factors. It may reduce sensitivity somewhat too. If the set still oscillates after neutralization has been attempted, an open bypass capacitor in one of the receiver stages is the next possibility eligible for suspicion.

Other adjustments will vary from one version to another. In the particular one shown here (Fig. 1), C_8 is adjusted for maximum output while the receiver is tuned to 91 mc.; C_{12} is adjusted on 100 mc. Careful adherence to the alignment method and sequence recommended by the manufacturer for any version encountered is even more important than usual with these circuits.

This design is enough of a challenge to technicians so that many manufacturers recommend factory repair only. However the properly equipped and adequately oriented technician can avoid this measure in most cases.

The infiltration has already begun. You may see many of these front ends before long. Take your time with them until you know what you are doing. Know them, and their owners will know you.

—30—

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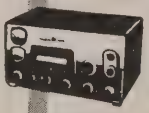

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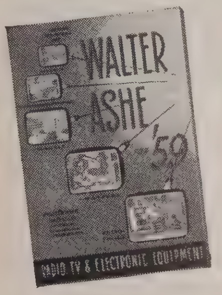

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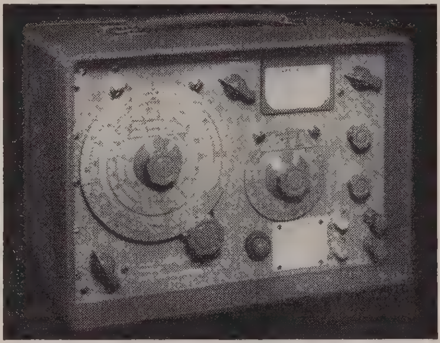
What's New in Radio

PORTABLE FM GENERATOR

Marconi Instruments, 111 Cedar Lane, Englewood, N. J. has just announced the availability of a compact, lightweight FM signal generator, the Model 1064/2.

Designed especially for mobile radio service work, the new instrument provides coverage of all mobile bands to 470 mc. A converter for coverage up to 960 mc. will be available shortly. Fully stabilized a.c. power supplies are used for maximum stability and tubes using directly heated cathodes shorten warm-up time to only a few minutes.



Output down to .05 μv. (with 10:1 attenuator pad) is controlled by a precision piston attenuator and FM is applied from an internal 1000-cps oscillator or from an external source. The carrier frequency can be shifted by accurately calibrated amounts for measuring receiver bandwidth and discriminator symmetry.

The manufacturer will supply complete specifications and price on request.

MOTOROLA'S A.C. VOLTMETER

Motorola Communications & Electronics, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill. has entered the electronic instrument field with a low-cost, all-transistorized battery operated a.c. voltmeter.

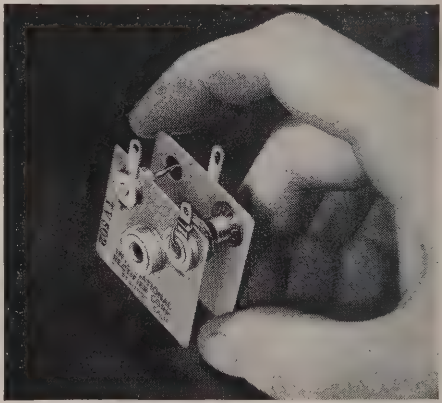
The new unit has full-scale readings of 1 millivolt to 300 volts in 12 ranges with essentially flat frequency response of 20 cycles to 1.5 mc. It has a db scale and a "battery OK" scale. High input impedance of 10 megohms shunted by 15 μμf. is provided in the 1-300 volt range and input impedance of 1 megohm shunted by 25 μμf. is provided in the 1-300 millivolt range. Accuracy is ± 5% up to 1 mc. and the unit is usable as an indicator up to 5 mc.

The power supply of standard batteries provides more than 400 hours operation. The instrument uses seven transistors, weighs approximately 5 pounds, and measures 5" x 5" x 10". The entire unit is housed in a sturdy steel case.

REPLACEMENT RECTIFIERS

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, Calif. is now offering replacement rectifiers for color TV sets.

The new silicon rectifier stack measures only 1½" x 1½" x 15/16" and is rated at 750 ma. It will replace original rectifiers in *RCA* color TV sets (Chassis 21CT660-2,3,4); *Raytheon* Chassis 21C-T1C; *Sylvania* Chassis 31C606; and other color TV sets having doubler power circuits. This single TV-502 silicon stack will also replace two selenium rectifier stacks in all black-and-white TV sets that use twin selenium stacks in a doubler circuit.



Eyelet construction permits direct replacement of original units, with no holes to drill, no conversion kit required. These new replacement rectifiers are now at the firm's distributors throughout the country.

SMALL-PARTS STORAGE

Akro-Mils, Inc., 820 E. Market St., Akron 9, Ohio is now offering a new series of transparent, plastic-drawer cabinets which has been specifically designed for the storage of resistors, capacitors, terminals, switches, tubes, wire, screws, solder, flux and other items to be found in the service shop.

Two basic drawer sizes measure 2" high, 11" deep, and 3" wide (Model M3) and 2" high, 11" deep, and 4" wide (Model M4). The drawer is molded of durable one-piece plastic with a pull handle at the front. A stop tab at the rear limits travel and prevents spillage. Full length runners add strength and make sliding easy. Self-adhesive drawer-front labels and inside label slots are provided for indexing the contents of each drawer. Flexible partitions are also supplied.

A complete data sheet on this "M Series" of cabinets will be forwarded upon written request to Department EW of the company.

PEAK-TO-PEAK V.T.V.M.

Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y. has recently introduced the Model VT-1 vacuum-tube voltmeter which features a single all-purpose probe which is said to do the work of four probes.

The "Multi-Probe" can be set to function as a d.c. probe, an a.c. probe, low-capacity probe, or r.f. probe by simply twisting the rotating head. A special holder on the side of the instrument case keeps the probe firmly in place and readily accessible.

The v.t.v.m. is powered by long-life batteries and features a 6-inch 100 μa. meter with multi-color scale. It is shipped fully wired and calibrated and is housed in a hammertone finish steel case.

For further information, complete specs, and price, write the manufacturer direct.

ARCO "5-PAKS"

Arco Electronics, Inc., 64 White Street, New York 13, N. Y. is now packaging a service assortment of "Elmenco" DP dipped Mylar paper capacitors in handy moisture proof transparent "5 Pak" bags.

Each bag contains five capacitors in values from .001 to .25 μf. at 600 volts and from .001 to .05 at 1600 volts. The new units are designed to simplify inventory control for both jobbers and technicians.

The capacitors are phenolic resin coated to withstand four times more humidity than the average molded capacitor, according to the company. High reliability is claimed at full rated voltage up to 110 degrees C constant operation. All values are ± 10%.

For further information on these new "5-Pak" assortments, write the company direct.

NEW SERVICE PROBE

King Research Laboratories, 801 So. 11th Ave., Maywood, Ill. is now in production on a new device for electronic technicians.

The "Miracle E" probe is designed to test radio and TV type rectifiers; check continuity and indicate resistance up to 400 ohms; test small transistors and crystal diodes in the circuit; check

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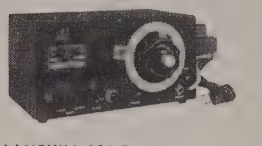

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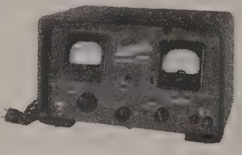

LAMPKIN 205-A FM MODULATION METER. Measures peak FM swing ±12.5 kc. or ±25 kc. on transmitters from 25 to 500 mc. in one band. Price $240.00 net.

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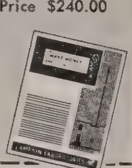

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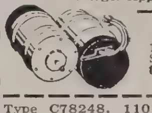

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transistors for weak, open, or shorted condition; indicate polarity for speaker phasing; and check polarity of a dry rectifier or for type classification of a transistor.

The "Miracle E" probe, which was designed by a practicing service technician, is being marketed as the Model JK-1. Write the manufacturer for additional details and price.

TRANSISTORIZED CONTROL UNIT

Perma-Power Company, 3100 N. Elston Ave., Chicago 18, Ill. is now marketing a transistorized transmitter to be used with its radio-controlled garage door opener. The two-transistor unit is self-contained and completely portable.

The new device will operate for more than a year on one inexpensive battery. It weighs only 12 ounces and is small enough to be carried in pocket or purse, stored in the glove compartment, or snapped on the sun visor of the car. Costly car installation is eliminated and the transmitter may be transferred from one car to another. The transistorized transmitter may be used to replace older model *Perma-Power* garage door control transmitters.

"LOCK-GRIPLIER"

Handicraft Tools, Inc., division of *X-acto, Inc.,* 48-41 Van Dam St., Long Island City 1, N. Y. is now offering the new No. 800 "Lock-GriPlier" which has been designed for the grasping and positioning of small objects in compact chassis.

The tool features a unique locking arrangement that permits its jaws to take a firm, non-slip grip on small washers, brads, screws, wires, and other hard-to-handle objects. The design permits use of the tool as a vise while performing operations like soldering where both hands must be kept free. In soldering applications the tool acts as a heat sink.

A little over five inches long, the plier has case-hardened steel jaws. A pistol grip handle permits holding for extended periods of time without hand fatigue and provides greater leverage for gripping power. The trigger and locking key can be operated with one hand. Local jobbers are now stocking this tool.

6-METER CONVERTER

American Electronics Co., 1203-05 Bryant Ave., New York 59, N. Y. is now offering a 6-meter converter and companion power supply in kit form.

The converter, Model CB-6K, features crystal control, a 6BZ7 cascode r.f. amplifier and 6U8A mixer-oscillator, special pi-net coil with taps, over 100 db i.f. rejection, a noise figure of better than 4 db, power gain of 20 db, and compact size (2½" x 2½" x 5"). The converter draws 15 ma. at 117 volts d.c. and .85 amp at 6.3 volts a.c. which can be obtained either from the receiver or from the companion power supply, Model PS-1.

The converter comes complete with tubes and crystal for 7-11 mc. or 14-18 mc. Wired and tested models are also available at extra charge. The power supply is offered in both kit and wired forms.

Write the company for a copy of a data sheet carrying full electrical specifications.

ATR TRUCK "KARADIOS"

American Television & Radio Co., St. Paul 1, Minn. is now in production on an all-new line of truck "Karadio" sets.

Designed for trucks, boats, station

Enthusiasm for Koessler Sales Company's original Volkswagen mobile demonstration unit (see RADIO & TV NEWS, August 1958) was so great that the Los Angeles rep firm has added a second unit to its "fleet." The new demonstration "room" is a five-ton van mounted on a Chevrolet chassis. It carries its own 3.5 kw. a.c. power generator to permit on-the-spot demonstrations of a wide range of audio gear. The interior is done in grey Formica lighted by fluorescent fixtures. Comfortable seating is provided for customers. Complete mono and stereo demonstrations can be conducted. Koessler handles American Microphone, Audio Devices, Bozak, McIntosh, Magnecord, Thorens, Electro-Sonic, Glaser-Steers, and Alto-Fonic audio equipment in L. A. area.

KOESSLER SALES COMPANY
MANUFACTURERS REPRESENTATIVE
PHOENIX

wagons, small import cars, and compact U. S. models, the circuit features vibrator operation and 8-tube performance with six tubes. The set incorporates a tone control and tilt arrangement to suit the convenience of the driver.

The receiver measures 7" deep, 4" high, and 6½" wide. It is a single unit which is designed to be mounted overhead, in the dashboard, or under the dash—depending on the layout of the vehicle's interior. The set weighs 6 pounds.

Complete descriptive literature on this new receiver is available from the factory to any of our readers upon direct request. —30—

Your Business Position

(*Continued from page* 70)

squeeze. The higher taxes absorb a larger part of his business income; rising prices reduce the purchasing power of his dollars; and the do-it-yourself tube vendors take away a growing percentage of the home service-call business. The fourth negative factor in the situation is that most service dealers have been unable or unwilling to increase their labor and home service-call charges to keep them in step with the rising costs of doing business.

In the light of these trends, it is pertinent to inquire: What can the small, independent service dealer do to maintain his business volume and his personal income from it? Increase his charges for labor and home service calls? Improve his personal productivity? Reduce his overhead and operating costs? Hire another technician to help carry the overhead load? Merge with another small dealer to eliminate the overhead of one business while maintaining the over-all volume of both businesses?

While it is much simpler to talk about increasing labor charges than actually to do it in a business, some dealers, faced with the alternative of either doing that or folding up, have been surprised both by the lack of customer resistance to higher charges and the importance of the additional income they received without an increase in operating expenses. The service industry nationally needs to lift its sights on the monetary value of the services it is performing for the general public.

Many dealers could materially improve their business situations by developing and using a rigorous system of time control. *Time* is the major product a service dealer has to sell. Through a studied, systematic application of his working hours, the dealer-technician can improve his personal productivity and thus add income to his business.

It is questionable whether any small service dealer could make a substantial reduction in his overhead and operating costs. Actually, most electronic service shops need a face lifting. They need to be repainted and cleaned up to give the appearance of being the headquarters for competent, efficient service on electronic products.

If a business is not prepared and able to make a substantial investment in materials, equipment, and promotion, adding technical help is usually a short-cut to the poorhouse. Many dealers have made "good deals" with competent technicians only to learn later they have trained a competitor and handed him the customers to start his own business.

While the average service dealer is a rugged individualist, preferring to struggle along on his own, there have been some very successful mergers of small service businesses that have proven very satisfactory and profitable to the dealers involved. When a couple of experienced dealers can get along amicably as partners, their merged businesses will give them the advantage of most of the fringe benefits they would receive as employees of larger concerns.

The important thing for every service dealer to do is to give his business and his own future the benefit of down-to-earth, objective thinking. TV service has settled down to the tough grind of relentless competition. To survive and prosper, the dealer must have a "road map" of definite objectives and a studied plan for bringing business to those objectives. —30—

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SHURE'S "WIN A ROLLS-ROYCE" CONTEST

SHURE BROTHERS, Inc. of Evanston, Ill. is giving hi-fi fans a chance to win a $13,995 Rolls-Royce merely for listening to a dealer's demonstration of any Shure stereo phonograph cartridge and writing the best conclusion to the following sentence in 25 words or less:

"I like Shure high-fidelity stereo cartridges because . . . ."

Entry blanks are available at all of the firm's distributors. The contest ends August 31st.

No purchase is required of entrants but if the winner has purchased a cartridge he will receive a free round-trip for two to the British Isles in addition to the Rolls.

The company urges every audiophile to enter as the contest is free, fun, and chances of winning are good. —30—

PENNSYLVANIA HAM PICNIC

THE annual picnic and hamfest of the Pennsylvania Fone Net, Eastern Pennsylvania CW Net, The Third Regional Net, and Eastern members of the Early Bird TransCon Fone Net will be held August 23rd at Hershey Park, Pa.

This will be a family affair and attendees are asked to bring their own picnic lunches or purchase food from concessions in the park. Registration starts at 0800 at $1.00 per ham call. For advance registration call W3BNR, 423 Lafayette Ave., Palmerton, Pennsylvania. —30—

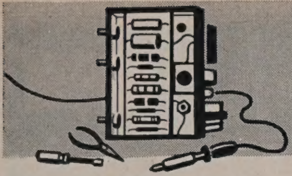
RAYTHEON INDIVIDUAL SERVICE BONDS

IN OPERATION for a number of years, Raytheon's successful "Bonded Dealer" program has recently been elaborated with a new feature that is expected to increase its popularity with the service profession. Participating establishments may now issue individual bonds to their customers on each service job, guaranteeing work performed. To validate the bond, the dealer must enter on it the date on which work was performed, number of the itemized invoice (a copy of which must be attached to the bond), and his own signature.

Underwritten by an established casualty firm, the bond covers claims up to $250 on any single repair job. It specifically covers only work performed for a period of 90 days, and also pledges that charges for parts do not exceed list prices, that components of recognized quality are used, that labor charges are reasonable, that only necessary work was done, and that reliable equipment was used.

Terms of the bond not only protect the customer and promote his confidence in the dealer, but they also benefit the dealer himself. The latter is protected against claims for damages and also against unfair charges where repaired sets give early trouble that had nothing to do with the work done. This careful distinction in writing in the bond between later faults involving work done and faults unrelated to this work should help resolve a frequent source of difficulty in service work. —30—

In Japan, Mr. Harry Resnick, president (right), and Mr. Harold Harris, vice-president (left) of Channel Master Corp. held a meeting with Dr. Hidetsugu Yagi, developer of the antenna type which made his name a permanent part of the language of television. The two executives met with the renowned scientist to discuss the growth of TV in Japan and the United States. Dr. Yagi's original paper describing the antenna was published in 1926. His antenna contained one driven element and a number of parasitic elements which would give it higher gain and narrower beam width. Now in his 70's, Dr. Yagi is a member of the Japan Academy, a member of the Japan Science Council, and president of the Musashi College of Technology. In addition to the above, the scientist heads his own television antenna company.



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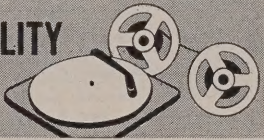

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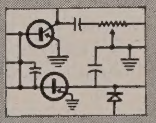

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TV Picture Tube rebuilding plant and training program still available for many territories. Investment $8,000-$11,000. Annual volume $25,000 to $100,000. Windsor Co., 999 N. Main St., Glen Ellyn, Ill.

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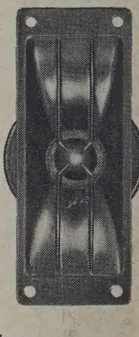

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